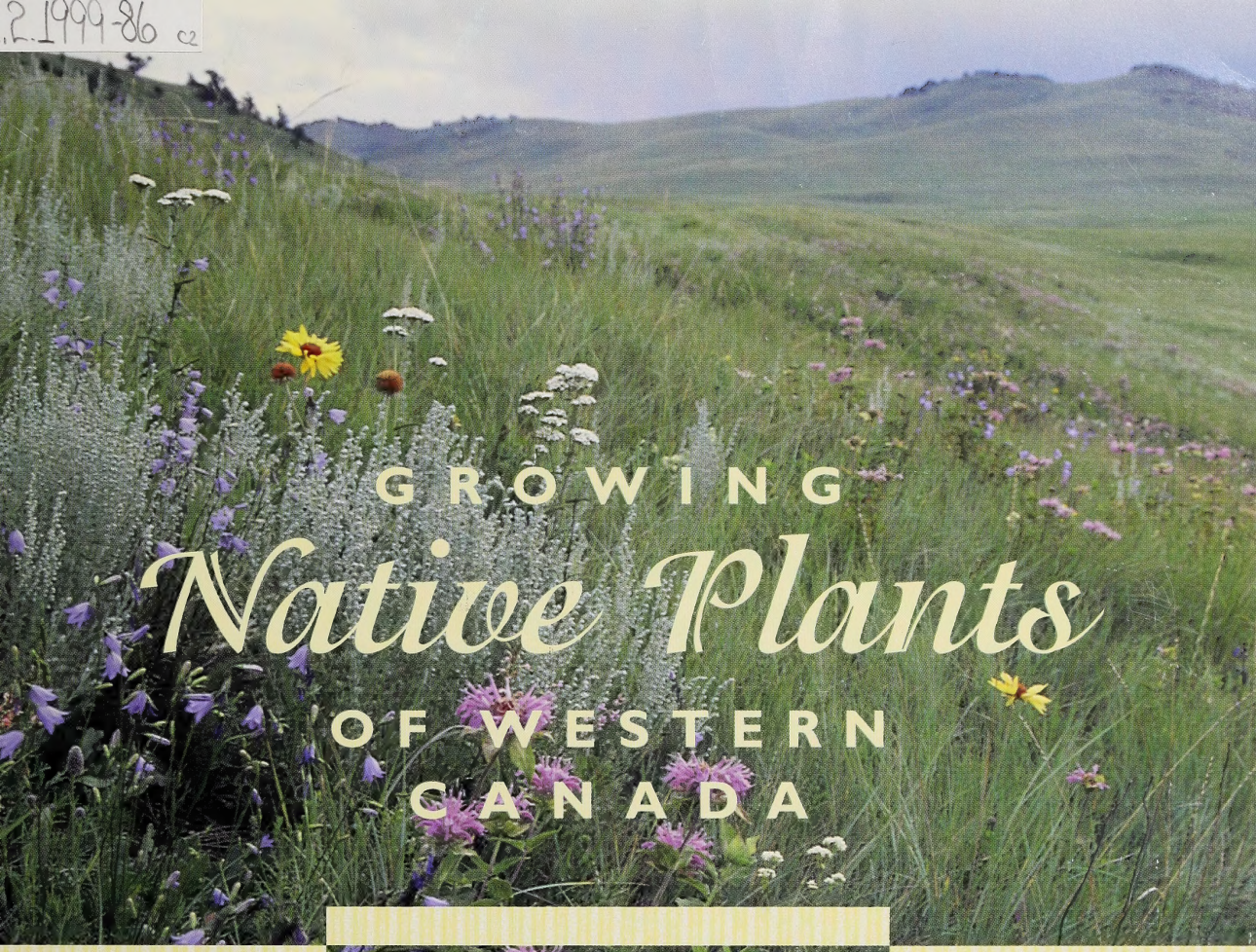
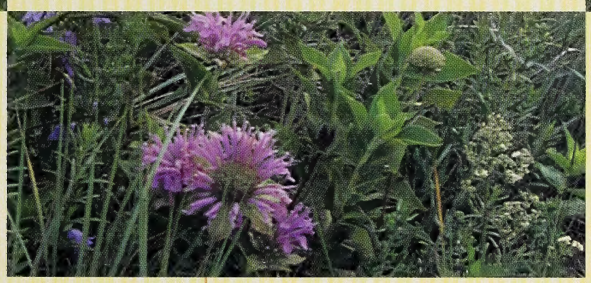
.2.1999-86 c2



GROWING *Native Plants* OF WESTERN CANADA



Common Grasses & Wildflowers

Copies of this publication may be purchased from:

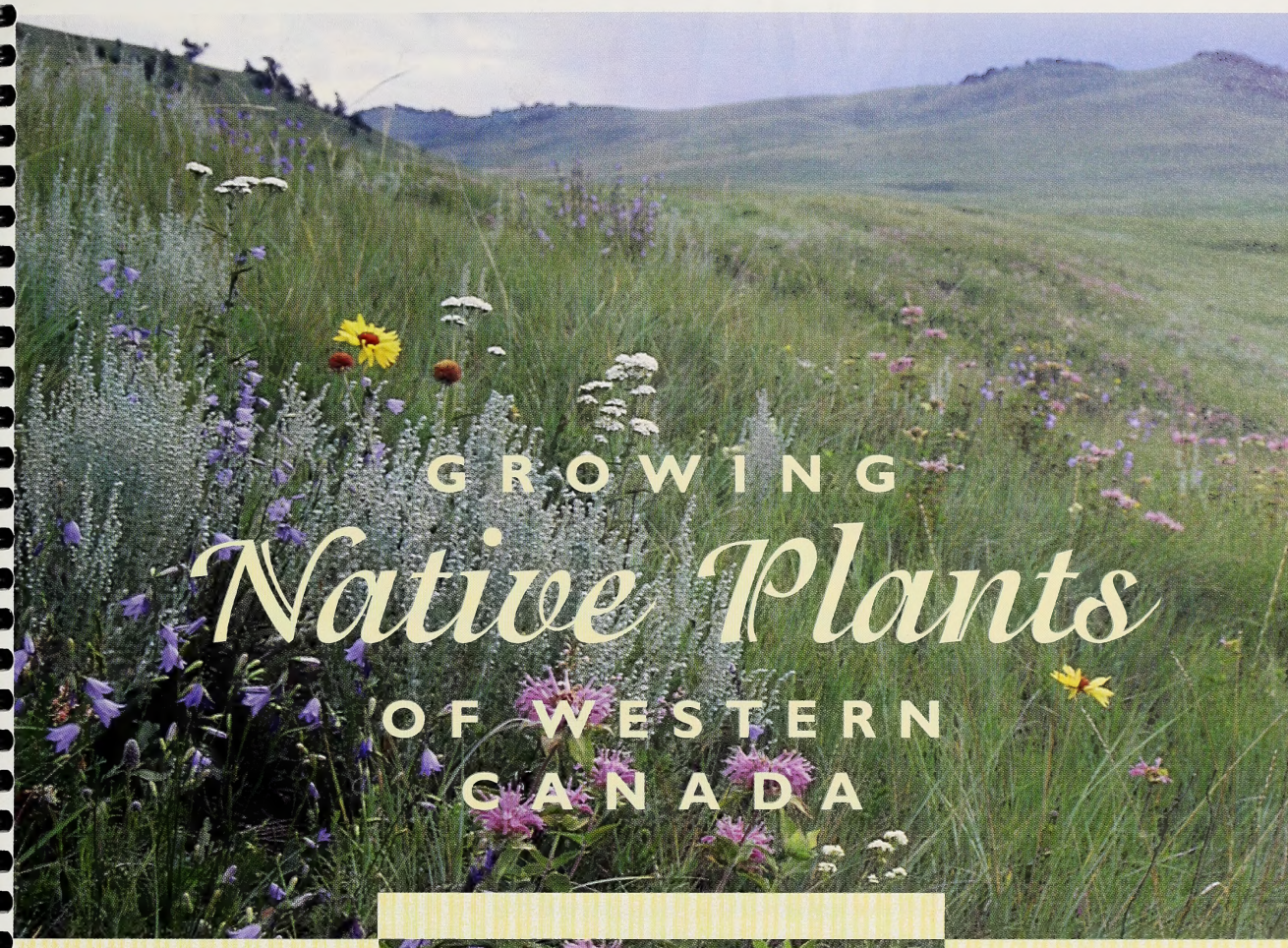
Publishing Branch
Alberta Agriculture, Food and Rural Development
7000 - 113 Street
Edmonton, Alberta
Canada T6H 5T6

Phone: (780) 427-0391
Toll free in Canada: 1-800-292-5697
Fax: (780) 427-2861

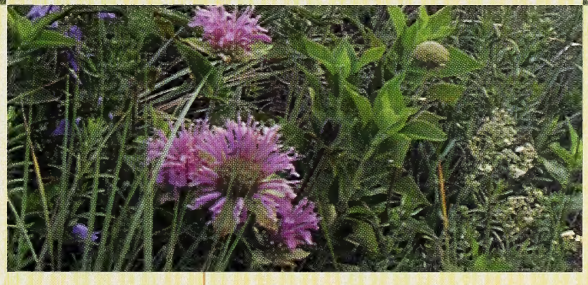
This publication may be cited as:

Pahl M.D. and A. Smreciu. 1999. Growing Native Plants of Western Canada: Common Grasses and Wildflowers. Alberta Agriculture, Food and Rural Development, and Alberta Research Council. ISBN 0-7732-6138-9. 118 pages.


National Library of Canada Bibliothèque nationale du Canada



GROWING *Native Plants* OF WESTERN CANADA



Common Grasses & Wildflowers

by M. D. Pahl and A. Smreciu

This guide is intended to provide government, industry and the general public with up-to-date information about the production of native plants for reclamation, restoration and landscaping. The opinions, findings and recommendations expressed in this book are those of the authors and do not necessarily reflect the views of government, industry, consultants or academics. Mention of trade names, commercial products or seed growers/suppliers does not constitute endorsement, or recommendation for use.

Cover Photo
by Gerald Haekel

Production Editor
Dave Orey

Graphic Design and Typography
Backstreet Communications Inc.

Published by:
Alberta Agriculture, Food and Rural Development
Publishing Branch
7000 - 113 Street, Edmonton, Alberta
Canada T6H 5T6

Copyright © 1999. Her Majesty the Queen in right of Alberta.
All rights reserved.

No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical photocopying, recording, or otherwise without written permission from the Publishing Branch, Alberta Agriculture, Food and Rural Development.

ISBN 0-7732-6138-9

Printed February 1999

ALBERTA RESEARCH COUNCIL

Alberta
AGRICULTURE, FOOD AND RURAL DEVELOPMENT

Acknowledgements

The information in this book is available largely due to native plants research done by the Alberta Research Council (ARC) at Vegreville, Alberta and Wild Rose Consulting, Inc. (WRC) of Edmonton, Alberta. The authors thank the key members of these teams for their work over the last 12 years. The key members include: Reinhard Hermesh, Surya Acharya, Barbara Darroch, Jay Woosaree, and Byron James, all of the ARC. A special thank you goes to Denise Pewarchuk (ARC) and Carcey Rowand (WRC) for helping to compile all of the information. A special thank you is also extended to Roberta Yakimchuk (WRC) and Jan Patterson of Alberta Agriculture, Food and Rural Development (AAFRD) for proof reading and editing.

The preparation and publication of this book was made possible by funding from Alberta Agriculture, Food and Rural Development's Public Land Management Branch and the Alberta Research Council. The authors would like to acknowledge Heather Gerling (AAFRD) for her support and encouragement throughout this project.

Walter Yarish (AAFRD) provided advice regarding the weedy status of some plants.

A few of the photographs were supplied by the authors, but most were kindly contributed by various agencies, institutes and individuals. The Alberta Research Council contributed all seed and seedling photographs, taken by Marion Herbut. The Council also contributed photos taken by Barbara Darroch, Denise Pewarchuk and Jay Woosaree. A special thank you to Kathy Tannas for providing numerous photos of prairie species. Other photographs were contributed by Gerald Haekel (Public Lands Management Branch, AAFRD), Richard Fyfe (through Alberta Public Works, Supply and Services) and Margaret Van Dyk.

Contents

About this Book v

Growing Native Plants 1

The Seed System 3
Collecting Seeds from Wild Lands 3
Choice of Cultivar or Population 4
Establishing a Stand 4
Land Preparation 4
Seeding Methods 4
Row Spacing 5
Timing of Seeding 5
Seeding Rate 5
Seeding Depth 6
Seed Germination 6
Stand Establishment 7
Companion Crops 7
Weed Control 7
Fertilizer 7
Stand Renovation 8
Other Considerations 8
Pollination 8
Genetics 8
Irrigation 9
Special Considerations for Wildflower Species 9
Vegetative Propagation 9
Symbiosis 9
Mycorrhiza 9
Rhizobial Bacteria 9
Insect Infestation of Legume Seed Lots 10
Harvesting 10
Harvesting from the Wild and Small-Scale Production 10
Large-Scale Seed Production 10
Swathing and Combining 10
Straight Combining 11
Strippers 11
Other Methods 11
Expected Seed Yield and Stand Life 11

Seed Processing 12
Drying 12
Threshing 12
Scalping 12
Debearders or Hammer Mills 12
Cleaning 12
Storage 13
Other Information 13

Grasses 15

Agropyron dasystachyum - Thickspike or Northern Wheat Grass 16
Agropyron smithii - Bluejoint or Western Wheat Grass 18
Agropyron subsecundum - Awned or Bearded Wheat Grass 20
Agropyron trachycaulum/A. violaceum - Slender/Broad-Glumed Wheat Grass 22
Bouteloua gracilis - Blue Grama 24
Bromus ciliatus - Fringed Brome 26
Calamovilfa longifolia - Sand Reed Grass, Prairie Sand Grass or Sand Grass 28
Deschampsia cespitosa - Tufted Hair Grass 30
Festuca hallii/F. campestris/F. altaica - Plains/Mountain/Northern Rough Fescue 32
Festuca idahoensis - Bluebunch or Idaho Fescue 34
Festuca saximontana/F. brachyphylla - Rocky Mountain/Alpine Fescue 36
Hierochloe odorata - Sweet or Holy Grass 38
Koeleria macrantha - June Grass 40
Poa alpina - Alpine Bluegrass 42
Stipa comata - Spear Grass or Needle and Thread Grass 44
Stipa curtiseta - Western Porcupine Grass 46
Stipa viridula - Green Needle Grass 48

Wildflowers 51

Achillea millefolium - Common Yarrow 52
Aster ericoides - Tufted White Prairie Aster 54
Astragalus alpinus - Alpine Milk Vetch 56
Astragalus flexuosus - Slender Milk Vetch 58
Astragalus pectinatus - Narrow-Leaved Milk Vetch 60
Astragalus striatus - Ascending Purple Milk Vetch 62
Campanula rotundifolia - Bluebell or Harebell 64
Gaillardia aristata - Blanket Flower, Brown-Eyed Susan or Gaillardia 66
Geum triflorum - Old Man's Whiskers, Prairie Smoke or Three-Flowered Avens 68
Glycyrrhiza lepidota - Wild Licorice 70

Hedysarum alpinum ssp. *americanum/H. boreale/H. sulphurescens* - American/Boreal/Yellow Sweetbroom 72
Liatris punctata - Dotted Gay Feather or Dotted Blazing Star 74
Linum lewisii - Wild Blue Flax 76
Oenothera biennis - Common or Yellow Evening Primrose ... 78
Oxytropis cusickii - Alpine Loco-weed 80
Oxytropis deflexa - Reflexed Loco-weed 82
Oxytropis sericea var. *spicata/O. monticola* - Early Yellow/ Late Yellow Loco-weed 84
Oxytropis splendens - Showy Loco-weed 86
Petalostemon purpureum - Purple Prairie Clover 88
Ratibida columnifera - Long-Headed or Prairie Coneflower 90
Solidago canadensis/S. rigida - Canada/Stiff Goldenrod 92
Thermopsis rhombifolia - Golden Bean, Golden Banner or Buffalo Bean 94
Vicia americana - American or Wild Vetch 96

Glossary 99
Geographical Abbreviations 105
Native Plant Councils 107
Bibliography 109
Species Index 115

About this Book

The rehabilitation of disturbed landscapes is a priority for environmentalists and land managers throughout the world. This includes the restoration of decimated ecosystems, the mitigation of wildlife habitat and the revegetation of disturbed industrial and agricultural lands.

Recently, Alberta Agriculture, Food and Rural Development's Public Lands Branch, Alberta Environmental Protection's Alberta Forestry Services and the Special Areas Boards have recommended the use of native plants for the rehabilitation of disturbances on public lands in Alberta. Although information about the adaptability and desirability of specific species is necessary, information on how to propagate and cultivate these species under field conditions is also needed. This book is designed to help fill this need.

At present, references are available describing individual plant species in their natural habitat, discussing suitability of species for use in reclamation and restoration, and outlining cultural practices. However, there is a need for this information to be brought together in one handy field reference and updated for the growing conditions and habitats of Western Canada.

The authors have over 30 years of combined experience in growing native plants in Alberta for use in reclamation and landscape rehabilitation. This experience is the basis for this book. The book covers 48 species of native plants that have shown promise for ecological repair. The information for each species includes general plant description, ecological context, propagation and cultural practices, role in reclamation/restoration, forage value and commercial availability.

This book also features numerous photos that allow the reader to identify plant material at the seed, seedling and mature plant stages.

This book will help anyone interested in collecting, growing and commercially producing native plants. Users might include private and public land managers, land reclamation engineers, conservation and reclamation consultants, range ecologists, wildlife and habitat biologists, seed producers, nurserymen, landscapers and gardeners.

For those interested in collecting seed from wild lands, this book will help identify species in the field, locate promising collection sites and indicate the best time to collect mature seed.

The propagation and cultural information, ranging from germination requirements to seed cleaning methods, will help commercial growers, landscapers and gardeners. The information on establishing native plants, specifically information on land preparation, seeding equipment, recommended seeding depths and expected establishment, will benefit land reclamation and restoration practitioners.

Seedling descriptions and photographs will allow early evaluation of new plantings for either commercial production or revegetation purposes. This expedites decisions regarding the need for remedial reseeding.

By providing information on the potential of individual species for use in reclamation and the importance of the role each species plays in an ecological context including wildlife and livestock utilization, this book will help reclamation practitioners, land managers and others select the species best suited to individual projects.

Recommendations on specific seeding mixes or seeding rates for use in revegetation or restoration are beyond the scope of this guide. However, the reader is referred to references listed in the back of the book.

Growing Native Plants



The Seed System

It is important to understand the seed system, whether you are purchasing, growing or marketing native seed. In Canada, the handling and sale of native plant seed falls under the Canadian Seeds Act and Regulations (1996). Seed is sold either as certified seed designated as to cultivar and species, or as common seed designated only to species.

A cultivar, also called a named variety, has undergone selection and development for improved agronomic traits such as ease of establishment or increased yield. Cultivars are structurally distinct and have documented performance records. Their genetic character is maintained by plant breeders through the production of breeder seed. Thus, many end-users consider them more predictable than seed from wild harvest.

Pedigreed seed always refers to a specific cultivar and is broken down into the following seed classifications: breeder, foundation, registered or certified. Bags of pedigreed seed are labelled with an official seed tag. Seed crops for each of these classes are produced under contract and must satisfy strict regulations for isolation distances and cropping history. They also have to meet high standards regarding genetic integrity, germination and purity (freedom from weed seeds, other crop kinds and inert matter).

For specific regulations regarding the production of pedigreed seed, refer to Circular 6-94, Regulations and Procedures for Pedigreed Crop Production, published by the Canadian Seed Growers Association.

Seeds that do not satisfy the above standards for germination, purity or genetic integrity are collectively sold as common seed. These are designated as Canada #1 or Canada #2, depending on level of weed seed contamination.

When acquiring certified or common seed from a supplier, a seed analysis report (certificate of seed analysis) should be requested. This report provides useful information on the types and amounts of weed species and other crop kinds, the amount of chaff or inert matter and per cent germination.

The seed analysis report should be reviewed in advance of acquiring seed. It allows the purchaser some quality control over the purchase item. When using your own seed from nursery stock or wild collections, a seed analysis report is still a good idea. Official seed labs conduct these analyses for a fee.

In the Canadian seed system there is no distinction made between seed collected from wild lands and seed from cultivars that has been downgraded for failing to meet quality standards. All seed is sold as common seed, without further designation as to genetic origin.

Demand for seed collected from wild lands or derived from nursery-grown wild stock is increasing. This is due to interest in restoration and reclamation efforts where local adaptation and genetic diversity are considered advantageous. However, guarantees concerning freedom from weeds and other purity factors are still of prime importance for those doing revegetation.

In the United States, the seed classification system has been modified to accommodate the demand for genetically-diverse seed by including extra seed classes for native plant species. The supplemental seed classification includes: source-identified, selected and tested classes. This provides intermediate classification levels between seeds collected from the wild or derived from wild stock (source-identified) and classical cultivar designations.

For many native plant species, Canadian cultivars or local seed sources do not exist. American cultivars are frequently imported and often sold as common seed in Canada. Many research institutions in Canada are currently developing ecological cultivars or "ecovars" of our own native plants that attempt to emphasize genetic diversity, specific adaptation and agronomic characteristics that satisfy current Canadian criteria for pedigreed status.

Collecting Seeds from Wild Lands

At present, wild lands are the only seed source for many native species. This means collecting seed from community pastures, rangelands, railway rights-of-way, pioneer cemeteries, military ranges, Indian reserves and roadside allowances adjacent to undisturbed areas.

Availability and accessibility for seed collection may be limited. Therefore, collecting seed from these areas involves considerable planning. On private lands permission is always required in advance of collecting seed. On public lands a permit, stipulating conditions for collection, is required.

Plants are most obvious and easily identified when in flower. As a result, pre-collection scouting trips should be made to identify promising collection areas while the plants are in full bloom. General habitat descriptions and geographical distributions for each species in this book will give some guidance for areas to search. However, once a collection site is identified, a collector cannot rely upon the same site year after year as seed production in natural environments is highly variable.

The timing of seed collection is one on the most crucial steps. Understanding the biology of the native plant species to be collected is a good place to start. Many native plant species have indeterminate flowering, where flowers and many different stages of seed maturity occur simultaneously on the same plant and even on the same flower stalk. Multiple seed collection trips are often needed to collect a significant amount of mature seed.

Actual dates for seed collection will vary depending on location. In addition, year-to-year variations in growing conditions influence when seed ripens. Hence, there is no method of accurately predicting optimum dates for seed collection. For each species, general flowering and seed ripening periods as found in nature are included in this book. These values are often reported as the number of days required from spring growth. However, there is no substitute for experience and familiarity with a species in your area to guide collection of seeds from the wild.

Care must be taken not to damage wild lands either through excessive trampling, soil compaction from equipment or over harvesting. Some native plant species around the world have been harvested or "wild crafted" to extinction. Canada already has its own casualties (e.g. American ginseng).

Never harvest all seed from any one collection site or repeatedly harvest a site year after year. A carry-over of 50 to 90 per cent is recommended. Extreme care should be exercised where rare or endangered plant species are found. Further guidelines for collecting wild seed can be acquired from your provincial Native Plant Council (see page 107).

Choice of Cultivar or Population

Considerable genetic diversity can be found within any one species. Therefore, species are often divided into groups that differ in their geographical adaptation and response to climate, soil and day-length. These groups are referred to as ecotypes. Some cultivars and ecotypes are adapted to areas to the south, where summers days are shorter. When exposed to Western Canada's cooler nights and longer summer days, they may winter kill, head poorly or flower so late in the season that seed does not have time to mature. It is important to grow not only species, but ecotypes or cultivars that are adapted to your area.

From a seed production point-of-view, local occurrence of a particular species may not be of primary importance. Seed production of many grassland species can be maximized by growing them in low-stress environments, where moisture conditions are less limiting. Often this can be done slightly north of their origin. Hence, collection sites (origin) are frequently south of production sites and/or release sites. The cultivars named in this guide are listed with their release site.

Before acquiring seeds from a supplier, always obtain as much information as possible, including whether the cultivar/population has been successfully grown in your area. More information on specific cultivars, including expected seed yields and collection sites or cultivar origin, can be found in the varietal descriptions published in scientific journals. It is also available from organizations responsible for the maintenance of breeder seed.

This book often refers to populations of a native plant species. A population is a very loose term that is applied here to any non-cultivar seed including nursery-grown material, wild harvest or selected strains. In fact, it can refer to any group of plants or seeds of the same species that have the potential to inter-breed. While "ecotype" infers specific adaptation, "population" does not as it may refer to a haphazard group of individual plants.

Establishing a Stand

Land Preparation

A clean, firm seedbed is one of the most important considerations when seeding native plants. As with many tame forages, seeds of native plants are relatively small and have low food reserves. A firm seedbed conserves soil moisture, allows for good contact between the seed and the soil, and ensures a shallow seeding depth.

A common practice in the Prairie provinces is to seed into clean stubble early in the spring or late in the fall. Seeding later in the spring usually requires a cultivation or spraying operation prior to seeding to control weeds. Except on heavy clay soils that tend to crust, cultivated land should be packed before seeding. Generally, the seedbed is of correct firmness when footprints are barely visible. For low-growing species, packing prior to seeding also creates a smooth seedbed by burying small stones. This assists with swathing procedures at harvest time.

Seeding Methods

Native plants may be seeded using a variety of equipment, but often an ordinary grain drill is used. Drills should be equipped with press wheels or be followed by a packer, except on heavy clays that are likely to crust. A grass seeder attachment is a good option.

Grain drills may be difficult to set for small-seeded native species. Seed carriers are used to bulk up volumes. Seed carriers are also used to improve seed flow as chaffy species tend to bridge over seed cups, resulting in plugging. Examples of seed carriers include cracked or roasted grain, vermiculite, phosphate fertilizer or a similar type of inert material. If a phosphate fertilizer is used (such as 11-52-0), the application rate should be less than 34 kg/ha (30 lb/ac) to prevent burning.

Commonly recommended seeders include the Truax, Tye, Nesbit, Brillion, John Deere Rangeland drill and John Deere power drill. Most specialized seeders have drill-box agitators to improve the flow of chaffy seed and prevent the sorting of seed and carrier. Air-seeders are also gaining popularity, but ensuring shallow seeding depth for small-seeded species is difficult. When seeding extremely small-seeded species, broadcasting is another viable option. Seeds can be broadcast using a variety of equipment. Broadcasting can be followed by a light cultivation or harrowing, or simply packed to await favourable moisture conditions. Generally, higher seeding rates (usually double) are required for broadcast than for drilled plantings.

Row Spacing

Row spacing can vary from six to over 40 inches (15 to 102 cm). Spacing is obtained by blocking off drill runs or by using a special row seeder. In drier areas, such as the Brown Soil Zone of Western Canada, stands established with wide-spaced rows (also referred to as row cropping) often yield more than stands using narrow-spaced rows. Row cropping may be essential to ensuring a seed crop in drought years. Wide-spaced rows are also used where selective herbicides to control weeds in native crops do not exist. However, the use of wide-spaced rows may require the use of specialized equipment such as inter-row cultivators or inter-row herbicide sprayers. It can also mean an increase in the number of field operations and higher maintenance costs.

Wide-spaced rows produce a more open stand. These do not compete as effectively with emerging weeds as denser stands established with narrower rows. Where soil moisture is less limiting, such as the Black and Grey Wooded Soil Zone or land under irrigation, narrow-spaced rows can have a considerable yield advantage over wide-spaced row. This is especially true in the first production year. Seed yields from narrow-spaced rows may be lower in following years.

Suggested row spacing is given under recommendations for each species to encompass a wide range of climatic and soil conditions. The final choice of row spacing will depend on the species, climate, available equipment and management approach.

Timing of Seeding

Optimal conditions for seeding cool-season species occur in early spring, but stands can be seeded until mid-June without marked effect. Seeding later in the season can reduce yields in the following year.

Warm-season species should be seeded only after soils have warmed up, usually from late May to mid-June. Mid-summer seeding is usually avoided for all species due to excessive heat and the potential for drought conditions.

Cool-season grasses and some wildflowers may be seeded in early fall, but legumes seeded after mid-August may winter kill during the first winter. Cool-season species can also be seeded in late fall just prior to freeze-up, but this is not a common practice. The seed may be vulnerable to unexpected fall/spring thaws and subsequent re-freezing. The success rate for late fall seeding is usually reported to be about 50:50. Nonetheless, fall seeding has been recommended for species and/or populations with large proportions of dormant seed (e.g. *Stipa* spp.). Winter conditions may be sufficient to stratify dormant seeds (see Seed Germination, page 6) and may improve overall emergence the subsequent spring.

Seeding Rate

Seeding rates for establishing a native seed crop are much lower than those used for most revegetation operations. This is because thin, open stands generally produce more seed than dense stands. However, individual rows should be seeded dense enough to fill in by the second year to effectively compete with weeds. Lighter seeding rates should be used where soil moisture is limiting. Suggested seeding rates are given under the specific recommendations for each native species. They are based on the assumption that seeds with good germination (80 to 100 per cent) will be used. For seed with lower germination, seeding rates should be adjusted upwards. Alternatively, seeding rates are sometimes based on "live" seed as determined by tetrazolium testing (TZ). This is especially true for species with high levels of dormant seed. Values for both per cent germination and per cent TZ viability are found in seed analysis reports.

Drills can be calibrated for the desired number of seeds per linear metre or foot of seeded row. This is done by operating the drill across a concrete floor or wide tarpaulin and counting the seeds dropped. If desired, seeding rates can also be converted to seed weight per unit area and the seeds dropped for a measured area can be weighed.

Seeding rates based on kilograms per hectare (kg/ha) can be determined by dividing the recommended number of seeds per linear metre of row by both the row spacing to be used

(in metres) and the number of seeds per kg, and then multiplying by 10,000 (the number of square metres per hectare). The calculation for western wheat grass is: 82 seeds/m ÷ 0.6 m row spacing ÷ 242,500 seeds/kg x 10,000 sq. m = 5.6 kg/ha.

Seeding rates based on pounds per acre (lb/ac) can be determined by dividing the recommended number of seeds per linear foot of row by both the row spacing to be used (in feet) and number of seeds per lb, and then multiplying by 43,560 (the number of square feet per acre). The calculation for western wheat grass is: 25 seeds/ft ÷ 2 ft row spacing ÷110,115 seeds/lb x 43,560 sq. ft = 5 lb/ac.

Seed weights for each species will vary with the cultivar or population, seed maturity and environmental conditions at time of seed development. Seed collected from the wild is usually lighter than nursery grown seed. Average seed weights are reported under specific recommendations for each species.

In addition, the purity of a given seed lot should be taken into consideration when finalizing seeding rates based on weight of bulk seed per unit area. Seed lots vary in the amount of chaff and weeds or other non-crop seeds they contain. Again, refer to the seed analysis report for per cent purity values. Make adjustments accordingly. For example, if a grower wishes to seed at 5 lb/ac of pure live seed (PLS) and the seed analysis certificate reported purity at 75% and germination at 66%, then the actual seeding rate would be 10 lb of bulk seed/ac [Calculation: 5 lb PLS/ac ÷ (0.75 purity x 0.66 germination) = 10 lb bulk/ac].

Seeding Depth

When seeding native crops, seeding to moisture is the best practice as long as this is not too deep. More stands are lost by deep seeding than by any other means. As a general rule of thumb, seeding depth should be no more than five times the diameter or width of the seed. Seed drills equipped with depth bands, and a firm seedbed are the best means of ensuring a shallow seeding depth. Extremely fine seed, including many wildflower species, is best broadcast on the surface and packed.

A range of seeding depths is given under specific recommendations for each species to encompass a wide range of climatic and soil conditions. Seed should be planted at the deeper depth on sandy or dry sites.

Seed Germination

The germination for any given species is dependent on the cultivar or population, seed maturity, environmental conditions at time of seed development, storage conditions and age of seed. The germination values given are typical for each species under optimal growing and storage conditions. Seed germination has been reported as the number of days imbibed seeds require at standard laboratory conditions [22°C, light (8 hrs) /15°C, dark (16 hrs) daily cycles] to reach maximum germination.

Many native plant species exhibit some degree of seed dormancy, a mechanism that prevents seeds from germinating even when provided with favourable conditions. This has adaptive value under natural systems by synchronizing germination with the optimal season of growth and/or by spreading germination over time. However, seed dormancy can be a major obstacle to those attempting to propagate native plants. Specific pre-treatments for germination enhancement have been included for each species. These pre-treatments should only be applied on specific seed lots where a high degree of dormancy has been determined. Indiscriminate use of pre-treatments can reduce germination.

Common methods for breaking dormancy include stratification, scarification and chemical treatment. A combination of treatments types may be needed to break dormancy in some species.

Pre-chilling or stratification (placing imbibed seeds at cool temperatures) for a period of two weeks to two years can break seed dormancy in many species. For the purposes of this guide, unless otherwise stated, stratification refers to a treatment where imbibed seeds are kept at approximately 4°C for two weeks prior to placement under standard germination conditions.

Scarification refers to any treatment that physically disturbs the seed coat and allows moisture penetration and/or the expansion of the growing embryo within the seed. This is accomplished by scratching or nicking the seed coat (e.g. with sand paper) or placing seed in acid baths (concentrated sulphuric acid or hydrochloric acid) for various lengths of time. Mechanical scarifiers are commercially available for large-scale production. They range in size from large industrial units to table-top models. Legumes generally require scarification due to their hard, impermeable seed coats (physical seed dormancy). Seed germination for many legume species is reported with and without scarification in this publication. Scarified seed should be seeded or germinated within a week or two as most species lose viability over time.

A third approach uses various hormones such as gibberellic acid (GA) to break dormancy. In this guide, GA pre-treatment refers to immersion in a GA bath (300 ppm GA solution) for 45 minutes. Seeds are then placed under standard germination conditions.

Following harvest, some species require an after-ripening period to optimize germination. After-ripening is a process whereby dry seeds lose dormancy over time. This is thought to be somewhat independent of storage conditions. The length of this after-ripening period varies greatly among species and populations. It can range from one to three months, to over two years. Populations selected for low initial levels of seed dormancy require only a short after-ripening period.

Stand Establishment

Ease of establishment varies considerably from species to species. Seed dormancy, as discussed in the previous section, can interfere with establishment of a uniform stand required for seed production. Even in species with low levels of seed dormancy, some species are more sensitive than others to the environmental conditions at the time of emergence. Once emerged, species vary with regard to their degree of vigour, their competitiveness and the time to first seed crop.

Companion Crops

Many native species are not very competitive and should be seeded alone. Companion or nurse crops are not recommended as stands of native species may fail to produce a seed crop in the following year where companion plantings are used. Where there are concerns about drifting soil or where run-off or irrigation may wash out young plants, standing stubble can provide the necessary protection. If a companion crop must be used, flax or oats are good choices. They should be seeded at one third the normal rate and cross-drilled or planted in alternate rows to the native crop. This will provide the least competition for new seedlings. To further reduce competition from the companion crop, avoid high application rates of nitrogen fertilizer and harvest the companion crop as early as possible. For example, a cereal could be harvested for green feed.

Weed Control

A clean seedbed is the best place to start a weed control program. Weeds, especially established weeds, can out compete a new planting and severely reduce seed yields in subsequent years. Some weeds produce seed that cannot be easily separated from the desired native crop and may reduce the overall grade and/or acceptability of seed harvested. For example, growing larger seeded grasses (wheat grasses, native brome grasses or rough fescues) in fields where quack grass, crested wheat grass or smooth brome are a problem is not recommended. Seed lots contaminated with these species will likely be rejected by potential customers. Likewise, seed lots of native bluegrass species contaminated with Kentucky bluegrass, or native milk vetches contaminated with sweet clover may be rejected. Downy brome and noxious weeds such as Canada thistle and leafy spurge are also a major concern. For a list of problem weeds that occur in your area, contact your local weed inspector or agricultural fieldman.

Summer fallowing in the year prior to establishing a native seed crop can significantly reduce the number of weeds. To control problem weed species, experienced growers recommend three applications of non-selective herbicides such as Roundup® (glyphosate) during the two to three years prior to establishing a native seed crop.

Surface cultivation or a "burn-off" treatment using a broad-spectrum herbicide in the year of seeding is usually a neccessary practice to create a weed-free seedbed. Deep cultivation prior to seeding should be avoided because it brings more weed seeds to the surface.

In some cases, once seedlings have emerged, selective herbicides can be used to control weeds. Bromoxynil (for seedling stands) and MCPA, 2,4-D and dicamba (for established stands) are herbicides commonly used to control broad-leaf weeds on grass seed crops. However, few herbicides are registered for use on native seed crops and the tolerance of most native species to existing herbicides is unknown. For specific information on the use of herbicides, refer to the current issue of Alberta Agriculture, Food and Rural Development's publication, *Crop Protection with Chemicals*, or contact company or government representatives in your area.

Mowing is an alternative approach to controlling annual weeds during the first year. The mowing height should not be too low (10 to 15 cm or 4 to 6 in) and annual weeds should be allowed to develop to the early seed head stage.

Frequent inspections of seed fields allows for the early detection of weed problems. Where a localized area of field contamination occurs, spot spraying with non-selective herbicide such as Roundup® can be used.

Hand weeding or roguing can also remove undesirable plants, especially in smaller fields. Roguing is an important component in the production of pedigreed seed where off-types and weed species need to be removed. Hand weeding is best conducted in spaced rows.

Where selective herbicides are not available for weed control, it may be necessary to row crop. Row cropping, in spaced rows at least 60 cm (24 in) apart, allows for cultivation between the rows using specialized field equipment, once or twice a year.

Fertilizer

Seed growers should have the soil of each field tested and any deficiencies corrected based on local recommendations. Nitrogen, phosphorus, potassium and sulphur are the nutrients that are most often

deficient in soils. Healthy, vigourous stands of native plant species produce the highest seed yields. However, available soil moisture and previous crop management will guide response to added fertilizers. Because phosphorus is not particularly mobile in soil, a common practice is to plow-down enough phosphorus to last for three years.

Nitrogen is the most important nutrient for grass seed production, but excessive nitrogen can lead to prolific vegetative growth and lower seed yields. Adding nitrogen is not recommended while seedlings are establishing as it tends to encourage growth and competition from annual weeds. As a general recommendation, 35 to 85 kg/ha (30 to 75 lb/ac) of nitrogen is sufficient for established stands under dryland production while 90 to 135 kg/ha (80 to 120 lb/ac) is sufficient for stands under irrigation. Old stands need higher rates than young stands. Nitrogen is usually applied in late fall or early spring. In addition, a light rate is often applied post-harvest for cool-season species. Excessive nitrogen may result in lodging, delayed seed ripening and when applied in late summer, an increased risk of winter kill.

Because of their association with nitrogen-fixing bacteria, legumes usually do not need applied nitrogen. However, other elements are still a concern for optimal production. The fertilizer requirements of most wildflowers have not been determined, but any marked soil nutrient deficiencies should be addressed.

Stand Renovation

To maintain high seed yields in most native seed crops, post-harvest residue must be removed. Removing residue reduces disease and insect problems and increases light penetration, stimulating increased and larger reproductive growth. The aftermath material can be used as hay or pasture. Moderate stocking rates should be used to avoid damaging the plant crowns, even though the aim is to substantively reduce residue levels. Alternatively, where native crops are unpalatable, seed stands may be close mowed and residues removed from the field. Burning is also a popular renovation practice for seed fields. Heavy swaths should be spread so they burn quickly and evenly, without forming hot spots that can cause damage. Check with your local municipality about burning by-laws as a permit may be required.

For most cool-season grasses, the best time to rejuvenate stands is immediately after harvest, before full regrowth starts. An early spring burn, prior to spring green-up, is an option for some species. Typically, warm-season grasses are rejuvenated in late fall after freeze-up, or in early spring. If legume stands are to be burned, burning should occur only in early spring as legumes are subject to winter kill when burned in the fall.

Some native species have aggressive rhizomes and over time these stands become sod-bound. A corresponding reduction in seed yield is often the result. These stands benefit from periodic inter-row and, for some species, cross-row cultivation.

Additional information on stand renovation is given under specific recommendations for each species only where there was direct experience with various practices.

Other Considerations

Pollination

Pollination refers to the transfer of pollen grains from the male portion of one plant to the female portions of the same or another plant. This process is the vital, first step for plants in setting seed. Self-pollination refers to pollen transfers on the same plant. Cross-pollination refers to pollen transfers between plants. One type or the other is usually favoured by a particular species. This affects the required isolation distances for growing pedigreed seed and maintaining genetic integrity.

Where pollen is light, such as in grasses, it is carried from one plant to another by the wind. Generally, forbs and legumes have larger, stickier pollen that is usually carried by insect pollinators. For most wildflowers, there is no need to manage pollinators to achieve adequate seed yields providing levels of naturally occurring pollinators are sufficient. However, native legume production may be enhanced by introducing colonies of bees in the immediate area.

Genetics

Under specific recommendations for each species, ploidy levels and possible hybridizers are listed. The ploidy level refers to the number of chromosome complements (n) that have been determined for the species. For example, individual plants of June grass may be diploid (2n=14) or tetraploid (2n=28). Hybridizers are other plant species that are known to form inter-specific hybrids with the native plant crop.

This information is listed because pollen transfers between plants of the same species, with different chromosome numbers or hybridizers, may affect seed production of the native seed crop. This can cause aborted seeds and the production of sterile plants. In pedigree systems, the genetic integrity of the cultivar and the use of recommended isolation distances between cultivars of the same species or potential hybridizers ensures that such effects are minimized. In stands established using wild seed stock, ploidy levels within the stand itself are likely to vary. This is not a concern in native crops with high seed yields. In any case, a minimum isolation distance of 100 metres (328 ft) should be maintained between cross-pollinating species that are likely to hybridize.

Irrigation

Irrigation is often used to maximize seed production in drier areas. Where stands are irrigated, moisture should be applied at sufficient levels to ensure stand establishment. Crusting damage is avoided by keeping the surface wet until the seedlings have emerged. Stands are irrigated in spring up until the boot stage if moisture is limiting (maintain at least 50 per cent field capacity). They are not irrigated during pollination. Although stands may be irrigated during early seed development, no irrigation is applied during seed ripening. Stands should be brought up to field capacity each fall.

Native seed crops that are grown under irrigation are more prone to diseases and pests. They also require greater amounts of fertilizer, are subject to lodging, may have delayed seed ripening and are prone to micronutrient deficiencies. In addition, grasses grown under irrigation tend to have more shattering than those grown under dryland production. However, yields are often substantially higher and more reliable from year to year. Heavier seeding rates and closer row spacing are used compared to dryland production.

Special Consideration for Wildflower Species

Vegetative Propagation

Although vegetative propagation is not widely used to produce grasses, many trees and shrubs are routinely propagated using these methods. Many of the forbs and legumes included in this publication can also be successfully cloned. In some cases vegetative methods, including sprigging, are recommended for increasing nursery stock.

The methods included in this publication are well documented (e.g. Hartmann and Kester 1997). These methods may or may not be suitable for producing large numbers of plants for reclamation, but can be used to increase nursery stock of many species.

Symbioses

Mycorrhizae

The individual plant descriptions include the general type of mycorrhizal association, if such information is available.

Many of the native wildflowers, and some of the native grasses, form root associations with specific soil fungi. The resulting root-fungal structures are termed mycorrhizae. These associations usually benefit the plant because the fungi allows them greater access to soil nutrients. Most of the fungi associated with the plants discussed in this book are from a specific group and form what are called Vesicular-Arbuscular Mycorrhizae (VAM).

Although some studies have shown that the introduction of these fungi into soils where these plants are used increases the success of the plants, little work has been done on isolating the particular fungi. Very few, if any, of these fungal strains are available commercially.

If topsoils are present, it is likely that these associations will form on their own. The addition of small amounts of the natural soils from where the plants were originally collected is probably sufficient to introduce the mycorrhizal fungi.

Morphologically distinct associations between dematiaceous surface fungi and roots have been reported for several of the species included in this book. They are common with specific pioneer plants found in alpine locations, especially on scree or talus slopes. The function of these associations is not well understood, but they are clearly not pathogenic. They may be mycorrhizal in nature.

Rhizobial Bacteria

Agronomic legume crops are inoculated with rhizobial bacteria that has been specially selected for a particular species. These form nodules on the legume roots and fix atmospheric nitrogen. There is some specificity of rhizobial bacterial strains with certain plant species. Some strains are more efficient and effective at fixing nitrogen with certain plant species or groups.

At this time there are no known inocula specially developed for the native legumes of Alberta, but there are more general inocula available on the market. Their ability to form effective nodules on the roots of the native legumes has not been tested, but perhaps they are worth trying. It would be wise to use inoculum that has been developed for closely related species. Native legumes grown in field nurseries in Vegreville were found to have nodulated with ambient rhizobial bacteria, but the efficacy of the nodules is not known.

Inoculum is applied in a sticky liquid that will make it adhere to the seed coat. It is done following scarification. Two tablespoons of corn syrup in one litre of water makes a suitable carrier. This should be applied to just moisten all the seeds in a seed lot. Prepared inoculum comes in a peat mixture. It should be sprinkled over the seed and thoroughly mixed such that all seeds are coated. The seed should be planted as soon as possible after it has been treated and treated seed should not be exposed to direct sunlight. Fertilizers should not be mixed with inoculated seed.

Although some species have been observed to nodulate in the wild at temperatures of 0°C, cool soil temperatures can be detrimental to nodulation. Shading or competing crops can also reduce nodulation.

Insect Infestations of Legume Seed Lots

Several insects lay their eggs in the flowers of legumes and seeds are often infested with the larvae of these insects. In warm storage the larvae become active and can decimate large seed lots. It is recommended that seeds, after they are dry, be stored at low temperatures, such as in a refrigerator at 3° to 6°C.

Harvesting

The timing of seed harvest is one of the most important decisions in the collection or production of native seed. Harvesting too early reduces seed viability and harvesting too late reduces seed yield due to excessive shattering. Most species do not ripen uniformly. Field variations, such as low moist spots or northern aspects, further compound this problem. Weather also plays a role in the amount of time it takes seed to mature. Hot, dry weather hastens ripening while cool, moist conditions will delay ripening.

Harvesting From the Wild and Small-Scale Production

Collecting seed from the wild usually means using hand methods because the native species do not grow in pure stands and topography often limits the use of mechanical equipment. For many native plant species, the best approach is to harvest the entire flowering stalk as opposed to just the seed head. This is best done when at least some seeds have fully ripened and a good portion of the seeds or pods are starting to turn colour. Place this material in brown paper bags or in cloth sacks. These can be hung or spread to dry.

By collecting the majority of the above-ground portion of the plant, immature seeds will ripen in the bag or sack. However, care must be taken to ensure that the material dries without moulding. This method is especially appropriate where flowers and seed are produced in leaf axils over the entire plant, or where seeds are borne in capsules that explode when ripe.

Seed can also be selectively harvested, taking only the ripe portions of the seed stalk. Ripe seeds may be stripped from plants using gloved fingers, hand-held stripper combs or small mechanical strippers that are available commercially.

Large-scale field equipment, such as headers, forage harvesters, mowers and balers, and field seed strippers, can be used where grass species occur in large enough stands and the topography permits the use of mechanical equipment.

There is also considerable interest in using non-selective means of harvesting seed from wild lands either as native hay or through the use of seed strippers. The resulting mixture contains seed from several species at varying degrees of seed maturity. Species composition and amount of trash varies widely depending on the equipment used, the specific species growing in the wild stand and the time of collection. Material collected in this manner is suitable for use in local restoration and revegetation projects. It is often applied directly, without much processing. This is done because the material collected contains a wide variety of seed sizes and types. This material is generally unsuitable for establishing seed production stands.

Large-Scale Seed Production

In most cases, a conventional grain combine can be used to harvest either a standing or swathed native seed crop. Before harvesting the combine must be thoroughly cleaned and adjusted according to the manufacturer's recommendations.

Most native species require very little wind over the sieves. The air intake should be adjusted based on seed weight. This prevents excessive amounts of seed from being passed through the combine in the straw and chaff (not more than five per cent). Setting the chaffer at 13 to 15 mm (½ to ⅝ in) and the cleaning sieve at 3 to 6 mm (⅛ to ¼ in) is a good starting place for making combine adjustments. It is important that an even, continuous flow of material is fed into the combine. A slow forward speed of 1.5 to 3 km/hr (1 to 2 mph) can reduce seed losses by 40 to 70 per cent.

The adjustment of the clearance between combine cylinder and concave bars is also important. A general rule is to have a clearance of 1½ times the thickness of long seeds or 1½ times the diameter of round seeds. Recommended cylinder speed and concave spacing have been given under specific recommendations for each species. Additional adjustments may be necessary to optimize harvest operations.

The following is only a guide and growers should use their own judgement and experience to make harvesting decisions.

Swathing and Combining

Swathing, followed by combining, is the most common method of harvesting native seed crops. Generally, this approach is used where stands ripen unevenly and crops are prone to shattering. However, the risk of light swaths blowing in the wind must also be considered. The ideal time to swath grass species is when seed is at the medium to hard dough stage. This can be determined using the thumbnail test. Firm thumbnail pressure is required to produce an imprint on the seed at the hard dough stage. Another indication of the hard dough stage is seed heads that easily shatter when roughly struck against the palm of the hand.

Moisture content can also be used as a good index of seed maturity. This can be determined by sampling several seed heads (clipped off just below the lowest seed branch) and using a

commercial moisture tester. Alternatively, moisture content may be determined by weighing the clipped seed heads before and after drying in an oven at 82°C (180°F) for about four hours. After oven drying, allow the seed heads to cool before weighing. Experience with specific species or even with specific cultivars or populations is often the best teacher when it comes to judging the ideal time to swath a seed crop.

The swather should be set to leave stubble that is sturdy enough to support the windrow and allow air to circulate and dry the swath. Under low-humidity conditions, drying time in the swath takes from five to 10 days. Easily shattered species should be swathed early in the morning or in the evening when the stands are dewy and the humidity is higher. To minimize seed loss, heads should be directed into the centre of the swath rather than flaring individual heads to the side. For some species, swaths are combined twice to ensure maximum seed recovery. The advantages of swathing are lower shattering losses, reduced need for post-harvest drying and easy removal of the aftermath. The disadvantages are swaths may be scattered or lost due to high winds, weather conditions can cause lower seed quality, lower germination due to immature seed and an increased risk of weed contamination.

Straight Combining

Small fields that ripen uniformly are the most suitable for straight or direct combining. Light stands that would not make substantive swaths are also direct combined. Combine when five to 15 per cent of the seed is still immature and some seed is just beginning to shatter. Harvest immediately if seed heads shatter when gently struck against the palm of the hand. Take as little straw as possible into the combine by adjusting the cutter bar to the highest practical height.

The advantages of straight combining are collection of more mature seed and a single harvest operation. However, straight combining usually results in higher seed moisture content which requires post-harvest drying before seeds can be safely stored. It also means a slower combine operation as more green material is run through the combine. In some cases, a second cut may be required to remove aftermath and straw.

Strippers

For large-scale mechanical harvesting, the seed stripper is an inefficient way of collecting seeds. Despite this, a number of native species cannot be harvested by other, more conventional means. Commercial products include pneumatic-type strippers, bluegrass cylinder strippers, suction seed reclaimers and brush strippers.

Grass fields can also be stripped with a modified grain combine. The cutter bar is covered with a section of split tubing and extra large bats are placed on the combine reel to swat the seed heads onto the combine table. For this system to work, the rotation speed of the reels needs to be increased to four or five times the normal operating speed.

The advantages of stripping are only mature seed is harvested and less chaff is left in the seed, resulting in higher seed quality and purity. The disadvantages may include an increased number of harvest operations, increased harvest and machinery costs, and higher seed moisture content requiring post-harvest drying.

Other Methods

Swathing may be difficult where short stature crops are grown. A mower equipped with a windrowing attachment may be used. Low-growing crops must be cut close to the ground and, as a result, a smooth seed bed is needed at harvest time. Some growers have success with mowing and baling crops that shatter seed easily. Bales must then be spread to dry in a well-ventilated, enclosed area. They can be threshed once dry. A combine can be used as a stationary thresher.

The use of chemical desiccants is another way to allow straight combining and to eliminate losses from wind damaged swaths. Several desiccants are on the market, but the tolerance of most native species to these has not been determined and its use may affect seed germination. Chemicals desiccants act on contact so a high spray pressure is necessary. This treatment is best used on open stands and standing crops. The crop should be ready to combine six to 10 days after application. Consult your agriculture or company representative for the latest recommendations and appropriate safety measures.

Expected Seed Yield and Stand Life

The expected seed yields and stand life reported in this guide are averages based on dryland production for Canadian cultivars, or where Canadian cultivars are not available, on a limited number of Western Canadian populations grown under dryland conditions at Vegreville, Alberta. Vegreville is located 100 km (60 miles) east of Edmonton in the Black Soil Zone. It receives an average of 40 cm (16 in) of mean precipitation annually. In some cases, where information on Canadian populations is unavailable, expected seed yields are based on American production.

As with forages, there is a wide variation in seed yield among cultivars and/or populations for any one native seed crop. In addition, seed

yields, even for specific cultivars or populations, will vary from year to year more so than many agronomic species like cereals. These variations are dependent on local environmental conditions and management practices.

Seed Processing

Drying

Seeds collected from the wild are usually not fully ripe at harvest. As a result, a period of time is needed between the collection of the seed and the threshing process. This allows the seed to mature and dry. Small lots packed in paper bags or cloth sacks can be placed in a warm, well-ventilated room or spread out thinly to dry.

On a commercial scale, the drying process usually occurs in the field between swathing and combining. Hence, swathed crops usually do not need supplemental, post-harvest drying. Although the ripening process may be complete when stands are straight combined or stripped, the seed moisture content is often too high for safe storage.

Storing seed with a high moisture content, even for short periods of time (a few hours), can greatly reduce germination. A commercial dryer, operated at a maximum of 38°C (100°F), can be used to artificially dry the seeds. Seeds can also be dried by spreading them in thin layers (7 to 12 cm or 3 to 5 in) in a bin and turning them frequently. A moisture content of eight to 13 per cent is considered safe for most species.

The moisture levels of harvested seed can be determined by weighing the seed before and after oven drying it at 54°C (130°F) for one hour. Allow the sample to cool before weighing it.

Threshing

For commercial operations, the process of combining carries out any threshing that is required. A combine is essentially a mobile thresher, complete with a fanning mill attached to a feeder section. The turning cylinder is used to rub the seed heads against the fixed concave bars. This produces the threshing action which breaks the seeds from the heads. Combines can also be used as stationary threshers by feeding harvested material into them.

For smaller lots, the threshing process is the same, but scaled down. Methods include rubbing the collected material against a coarse screen with a gloved hand or between rubber-padded seed boxes and paddles. Other techniques are to simply walk on the cloth bags containing dry, harvested material or to beat them against a wall. Mechanized threshers for small seed lots are commercially available or can be custom built.

Scalping

Scalping is a process whereby excessive stems and leafy trash are removed through coarse screening the harvested material. This assists the drying process and helps avoid heating. Heating can result in low germination rates and the loss of seedling vigour.

Debearders or Hammer Mills

The seeds of some grass species bear long beards or awns while the seeds of other grasses or wildflowers have hairs or wings. While these structures may have adaptive value under natural conditions, they reduce seed flow, make seed handling awkward and make large-scale seeding difficult. Debearders are used to remove these appendages from the seeds.

A debearder consists of a beater that rotates inside a drum. The beater is a shaft with projecting arms that move the seed mass through the drum. Stationary posts protrude inward from the drum and prevent the mass from rotating with the beater. The severity of action is controlled by exposure time, beater speed, clearance between the arms and post, and sample size.

Debearding can also be done with a properly regulated hammer mill. When doubles are a problem or fruits are tough to break, debearders or hammer mills are sometimes used to further thresh seed samples. However, caution should be used as hammer mills are designed to grind seeds for preparation of animal foodstuff and their improper use easily damages seed. Results will depend on the hammer speed, feed rate and the condition of the collected material. The feed should be regulated so that the mill is nearly full at all times and the hammer speed is about half what is normally used in grinding operations.

As long as harvested material is stored properly (dry), it is often best to leave much of the processing until the seed is needed for sowing. Debearding and other seed processing can damage seed coats and remove seed hulls. In some species, breaking the seed coat (scarification) may act to improve emergence and germination if the seed can be immediately planted or if favourable conditions are provided. However, seeds with damaged coats or removed hulls do not store well and rapidly loose their viability. Unfortunately, in most circumstances, seed lots must be fully processed before they can be graded and sold.

Cleaning

Many types of seed-cleaning machines are available that exploit the physical properties of seeds. (See Morgan et al. 1995 for a list of equipment suppliers). There are air-screen cleaners, specific gravity separators, pneumatic separators, aspirators, velvet rolls, indent cylinders, vibrator separators and others. Only air-screen cleaners, hand screens and seed blowers will be considered here.

The most widely used machine for cleaning seed is the air-screen cleaner, sometimes referred to as a fanning mill. Air-screen cleaners are available in a variety of sizes, from industrial to table top. They are commonly used in seed cleaning plants. The basic model uses two screens. Typically, seeds are gravity fed from a hopper into an airstream which evenly distributes the seed over the top screen. The top screen scalps by removing stems and other large material. The second screen allows fine trash to pass, but retains the seeds. The seeds are then passed through an airstream that drops the heavy seed, but lifts and blows away and discards light seeds and chaff.

Screens may be round, oblong, slotted, triangular or a mesh. Except for mesh screens, screen size is indicated by the diameter of its perforations. By convention, perforations larger than 5½/64th of an inch are measured in 64ths. For example, a No. 32 screen would have perforations with a ½ inch diameter. Smaller screens are measured in fractions of an inch. Wire-mesh screens are designated according to the number of openings per inch in each direction. A 10 x 10 screen has 10 openings per inch both across and down the screen. These conventions are used in this book.

The air flow of air-screen cleaners can also be adjusted, usually by means of baffles in the air ducts. The final choice of which screens to use depends on the seeds being cleaned, the contaminants in the mixture and the purity requirements that must be met.

Where seed lots are very small and conserving all the seed collected is desired, cleaning may be best conducted in two operations. Hand sieves and sample screens can be used to separate seeds and fine chaff from straw and other larger material. These screens are based on the same design as the larger air-screen cleaners. Hand sieves are commercially available and are shaken by hand or through the use of mechanical shakers. The fine chaff and dust can be removed from the seed by winnowing, using a seed blower. This machine consists of a motor-driven fan to supply air pressure, and baffles in a vertical plastic cylinder for separation. Seeds are dropped in the vertical cylinder and the air gate is opened until the airflow agitates the seed. Light chaff will float up. It will either go out the end of the cylinder or be collected in the upper baffles. Depending on the operation, the heavier seed will remain in the bottom or be collected in the lower baffles. This is a quick method for cleaning small lots of seed. Larger versions of this machine, using continuous-airflow systems, are also available. Alternatively, small samples may be effectively separated (winnowed) using a hand-held hair dryer with the heat turned off. Using natural winds is another option.

Storage

The storage life of native crop species varies and is affected by initial seed quality, seed moisture and storage conditions. Generally, for every one per cent reduction in seed moisture and every 4°C (10°F) reduction in seed temperature, seed life doubles. Cooler temperatures also limit damage by insect pests.

Unfortunately, most sub-freezing units have a high relative humidity and after a period of storage the seeds gain moisture and ice crystals form. These conditions damage cells causing a loss in viability. Seeds should first be dried and then placed in moisture-proof containers prior to being placed in sub-freezing conditions for long-term storage.

In practice however, large-scale seed storage typically uses unheated field granaries that do not regulate environmental conditions. Well-maintained, insulated, wooden granaries are better than metal granaries for storing seeds as they are less likely to over-heat in summer. The primary concern with this type of storage is the control of rodent pests.

The seed of many species can also be stored at ambient room conditions for two to four years (frequently longer) with out marked loss of viability. Legume species are noted for their extended shelf life, often measured in decades. In fact, seeds of many species may benefit from a storage period that allows after-ripening to occur (see Seed Germination, page 6)

Other Information

To set each species in an ecological context, general habitat descriptions, geographical distributions and plant associations are listed under specific recommendations. However, only common plant associations in which the species of interest comprises a major component are noted. Many species are widely occurring and form associations with many different plant species throughout North America. For more information regarding plant associations in Alberta, see Gerling (1996).

The forage value (for both livestock and wild ungulates) and forage classification have been given under recommendations for each species. Forage classifications used in this guide (i.e. increaser, decreaser and invader) follow Wroe et al. 1986.

Included with species descriptions are photographs depicting the mature plant, seedling and seeds. In some cases, two or three closely related species are included under one description for comparison. Unless otherwise stated, the description, photos and recommendations refer to the first plant species named at the top of the page. Seedlings of all wildflowers were photographed growing in root trainers. Each root trainer cell is approximately 2.5 x 3 cm (1 x 1¼ in). This gives the reader a reference point to determine plant size.

Definitions for terms and abbreviations used throughout this book can be found in the glossary at the back.

Grasses



Agropyron dasystachyum (Hook.) Scribn.

Synonym(s): *Elymus lanceolatus* (Scribn. & Smith) Gould



northern wheat grass

Plant

An erect, strongly-rhizomatous plant, 40-70 cm tall with shallow roots to 25 cm; deeper feeder roots to 50 cm. Similar to *A. smithii* in appearance, but generally greener, more tufted and often with hairy lemmas. Seed heads are spikes 5-20 cm in length, with a single spikelet at each node; spikelets 4-8 flowered; glumes 6-9 mm in length and broadened in the middle.

Vegetative Characteristics

Leaves to 6 mm wide, somewhat glaucous, flat or rolled inward, stiff, prominently ridged and rough (rarely hairy) on upper surface, smooth on lower surface, may be rough near the base, with rough margins, rolled at emergence; sheath round, split, prominently veined, sometimes brownish or purplish at the base; ligule to 1 mm long, blunt or rounded, lacerate; collar divided, light green; auricles to 2 mm long, claw-like, clasping, slender.

Seed

8-10 mm long; lemma sometimes with a short awn.

Habitat

Grasslands; requires 25 cm of annual precipitation; a drought and alkaline tolerant species; better adapted to coarser-textured soils than *A. smithii.*

Association(s)

In mixed and sparse stands with *A. smithii* and *Stipa comata* on clay and loam soils; occasionally in nearly pure stands on sandy lands.

Distribution

The most common wheat grass on the Northern Great Plains, and also found in the inter-mountain areas; BC to Man south to Calif, Ariz, Neb and Ill.

Phenology

Long-lived, cool-season perennial; starts growth in early spring; requires 115 days from emergence to seed set. Dense stands of *A. dasystachyum* seldom set seed; seeds mature in sparse stands by late July or early August.

Genetics

2n = 28, 42. Hybridizes with *A. trachycaulum, A. spicatum* (bluebunch wheat grass), and *Elymus innovatus* (hairy wild rye).

Pollination

Wind; cross-pollinating.

Seeding Methods

Row cropping recommended; 60-90 cm (24-36") row spacing; best seeded in spring.

Seed Weight

339, 600 seeds/kg (154,400 seed/lb)

Seeding Rate

82-98 seeds/linear m of row (25-30 seeds/linear ft)

Seeding Depth

1.2-2.5 cm (½- 1")

Seed Germination

98% in 5-10 days.

Stand Establishment

Excellent.

Harvest Methods

Expect first seed crop in the second year. Direct combine at the hard dough to mature seed stage or swath at the hard dough stage when seed

heads reach 40-45% moisture content; swathing recommended; lodging potential is high.

Harvest Date
Mid July

Shattering Potential
Moderate

Cylinder Speed
1200-1400 rpm

Concave Spacing
0.9-1.2 cm (⅜- ½")

Expected Seed Yield
200 kg/ha (180 lb/ac)

Stand Life
4-5 years

Seed Processing

Debearding
May improve seed flow (not always required)



seedling - 1 month

Cleaning
Top screen: 1/16 x ¼" slotted
Bottom screen: 6 x 24 mesh

Culture

Cultivated stands often becomes sod-bound over time (approx. 5 years) with a corresponding reduction in seed production. Frequent cultivation is necessary to maintain stand productivity. Under irrigation *A. dasystachyum* may be susceptible to leaf and stem rust.

Reclamation Role

This species has been widely used in revegetating various industrial disturbances including oil and gas well sites, pipeline construction areas, road side rights-of-way and mining spoils. It provides excellent erosion control.

Forage Notes

Cures on stem; average protein levels are 16% in May dropping to 4% in October. One of the most palatable and productive grasses of the Northern Great Plains. Quite tolerant of heavy grazing and trampling.

Grazing Response
Decreaser

Livestock Forage Value
Good

Wild Ungulate Forage Value
Good



seeds (x 1.1)

Cultivars

Canadian
Elbee (Lethbridge, Alta)

Other
Bannock (Ida & Ore), Critana (Mont), Schwendimar (Ore)

Agropyron smithii Rydb.

Synonym(s): *Pascopyrum smithii* (Rydb.) Love



western wheat grass

Plant

An erect, strongly rhizomatous plant, 30-60 cm tall with shallow roots to 25 cm; feeder roots to 150 cm. Leaves very rigid, glaucous blue, growing at a 45° angle to the stem; auricles often purplish giving rise to the name bluejoint. Seed heads are dense spikes, 7-15 cm long, with single (occasionally 2) spikelets at each node; spikelets 6-10 flowered; glumes 10-12 mm long, rigid, not broadened in the middle but almost straight-sided.

Vegetative Characteristics

Leaves to 6 mm wide, bluish-green, glaucous, flat or rolled inward, stiff, growing at a 45° angle, prominently ridged and rough (rarely hairy) on upper surface, smooth on lower surface, with rough margins, rolled at emergence; sheath round, split, prominently veined, sometimes brownish or purplish at the base; ligule to 0.5 mm long, blunt or rounded, lacerate or hair-fringed; collar continuous, not well-defined, light green; auricles claw-like, clasping, sometimes purplish at the base.

Seed

10-12 mm long; the lemma sometimes with a short awn.

Habitat

Grasslands; moderately saline and alkaline tolerant; tolerant of flooding; prevalent on Solonetzic soils.

Association(s)

Often in pure stands on Solonetzic soils or in low areas where water stands in the spring. On clay soils with *Stipa comata* and in sparse stands among *Bouteloua gracilis* and *Stipa comata*.

Distribution

BC to Ont south to nCalif, nNev, Ariz, Tex, Ark, Tenn.

Phenology

Long-lived, cool-season perennial; starts growth early in spring; requires 120-150 days for mature seed; flowering 2-3 weeks later than *A. dasystachyum*. Seeds rarely mature in natural stands of *A. smithii*.

Genetics

2n = 56; Interspecific hybridization is rare in this species.

Pollination

Wind; cross-pollinating; self-incompatible.

Seeding Methods

Row cropping recommended; 60-90 cm (24-36") row spacing; seed in early spring, late summer or just prior to freeze-up in the fall; fall seeding may be better suited for seed lots with high levels of seed dormancy.

Seed Weight
242,500 seeds/kg (110,115 seeds/lb)

Seeding Rate
82-98 seeds/linear m of row (25-30 seeds/linear ft)

Seeding Depth
1.2-2.5 cm (½- 1")

Seed Germination
67% in 5-10 days; germination is light sensitive; an after-ripening period of 6-12 months may improve germination for dormant seed lots. Pretreatment(s) for dormant seed lots: stratification.

Stand Establishment
Plants develop slowly from seed but they usually spread rapidly in their second year.

Harvest Methods

Expect first seed crop in the second year; harvest heads when brown but stems are still a little green. Direct combine at the hard dough to mature seed stage or swath at the hard dough stage; swathing recommended; lodging potential is high.

Harvest Dates
Mid August
Shattering Potential
Moderate
Cylinder Speed
1200-1400 rpm
Concave Spacing
0.9-1.2 cm (⅜- ½")



juvenile western wheat grass

Expected Seed Yield
112 kg/ha (100 lb/ac)
Stand Life
3-5 years

Seed Processing

Debearding
Sometimes required; can also be used to break up doubles
Scalping
Often required
Cleaning
Top screen: ¼ x ½" slotted
Bottom screen: 6 x 22 mesh

Culture

Cultivated stands often become sod-bound over time (approx. 5 years) with a corresponding reduction in seed production. Stand renovation is necessary to maintain productivity. This species is susceptible to *Claviceps purpurea* (ergot). *A. smithii* can also be susceptible to thrips, *Ophiobolis graminis* (take-all disease), and to leaf and stem rusts under irrigation. Stands respond well to mid-season moisture.

Reclamation Role

An early pioneer on disturbed sites within its range. Suitable for range improvement and revegetation of sodic soils or on disturbed sites where spring flooding is expected but seasonal drought occurs.



seeds (x 1.1)

Forage Notes

Cures on the stem; average protein levels 18% in May falling to 4% by October. Highly digestible; provides nutritious winter pasture and hay; used by mule deer, pronghorn and elk throughout the year.
Grazing Response
Increaser
Livestock Forage Value
Good
Wild Ungulate Forage Value
Good

Cultivars

Canadian
Walsh (Lethbridge, Alta)
Other
Ariba (Colo), Rodan (ND), Rosana (Mont)

Agropyron subsecundum (Link) Hitchc.

Synonym(s): *Elymus trachycaulus* ssp. *subsecundus* (Link) Gould, *Agropyron unilaterale* (Cassidy) Malte



bearded wheat grass

Plant

A loosely-tufted perennial 50-100 cm tall. Seed heads are spikes, 6-20 cm long, erect to slightly nodding, with a single spikelet at each node, often one sided. Very similar to *A. trachycaulum in* appearance except seed heads bear awns, 10-40 mm long and spikelets more closely overlap than in *A. trachycaulum.*

Vegetative Characteristics

Leaves to 10 mm wide, flat or rolled inward, ridged and rough on upper surface, slightly rough on lower surface, rolled at emergence; leaf margins white and very rough; sheath round, split, becoming hairless with age, prominently veined, sometimes glaucous; ligule to 1 mm long, blunt to rounded, lacerate, brownish; collar divided, distinct, light brown; auricles absent or only one. Young plants have densely hairy sheaths.

Seed

10-12 mm long, with a 10-40 mm awn.

Habitat

Prairie and woodland openings of the aspen parkland and the boreal forest to the tree line; best adapted to moist, well-drained, non-alkaline loamy soils; also prevalent on sandy soils within the moister part of its range; requires 32 cm of annual precipitation.

Association(s)

Often with *Koeleria macrantha* on sandy sites.

Distribution

In Western Canada, found more frequently in the western and northern portions of the Prairie provinces; Alas, Yuk, sMack to Huds Bay, Nfld south to Calif, NM, Mo, and wVA.

Phenology

Short-lived, cool-season perennial; starts growth early in spring; requires 110 days from emergence to seed maturity; seeds mature in late July to late August.

Genetics

2n = 28. Hybridizes with *Hordeum jubatum* (wild barley) and *Elymus innovatus* (hairy wild rye).

Pollination

Wind; self-pollinating.

Seeding Methods

Row spacings of 30-90 cm (12-36") recommended; narrow row spacings of 30-60 cm (12-24") suitable for the Black and Grey Wooded Soil Zones of Western Canada; best seeded in spring.

Seed Weight

246,300 seeds/kg (112,000 seeds/lb)

Seeding Rate

82-98 seeds/linear m of row (25-30 seeds/linear ft)

Seeding Depth

1.2-2.0 cm (½- ¾")

Seed Germination

95% in 6-10 days.

Stand Establishment

Excellent.

Harvest Methods

Expect first seed crop in the second year. Direct combine at the hard dough to mature seed stage or swath at the hard dough stage when seed heads reach 40-45% moisture content.

Harvest Dates

Late July to mid August

Shattering Potential

Moderate

Cylinder Speed
1000-1200 rpm
Concave Spacing
0.9-1.2 cm (⅜- ½")
Expected Seed Yield
300-500 kg/ha (268-446 lb/ac)
Stand Life
4-5 years

Seed Processing

Debearding
Required
Cleaning
Top screen: ¼ x ½" slotted
Bottom screen: 6 x 18 mesh

Reclamation Role

An early pioneer on disturbed sites; may be included in reclamation seed mixes as a nurse crop with slower establishing but longer-lived grasses. Also an important species for habitat restoration. Because the heads of this species are rarely grazed, stands of *A. subsecundum* provide cover for nesting birds and other wildlife.



seedling - 23 days



seeds before (left) and after (right) debearding (x 1.1)

Forage Notes

Basal leaves very palatable but stems and seed heads unpalatable and rarely eaten; similar nutritional pattern to *A. trachycaulum*; heavily used by Rocky Mountain elk in the fall.
Grazing Response
Decreaser
Livestock Forage Value
Good
Wild Ungulate Forage Value
Good

Cultivars

Canadian
Hillcrest (Vegreville, Alta)
Other
None

Agropyron trachycaulum (Link) Malte /*A. violaceum* (Hornem.) Lange

Synonym(s): *Elymus trachycaulus* ssp. *trachycaulus* (Link) Gould /*Elymus trachycaulus* ssp. *violaceus* (Hornem.) Love, *Agropyron latiglume* (Scribn. & Smith) Rybd.



slender wheat grass

Plant

A. trachycaulum: a tufted perennial 50-150 cm tall with dense roots to 50 cm. Seed heads are spikes, more or less open, 10-25 cm long, with a single spikelet at each node; spikelets 5-8 flowered. *A. violaceum:* considered to be a high-altitude subspecies of the former by some authorities; a tufted perennial 20-70 cm tall, with a semi-decumbent habit; dense spikes shorter than those of *A. trachycaulum*; spikelets 3-5 flowered; glumes very broad, thin margined, and awn-tipped.

Vegetative Characteristics

A. trachycaulum: leaves to 6 mm wide, flat, ridged and rough on upper surface, keeled and slightly rough on lower surface, with very rough margins, rolled at emergence; sheath round, split, sometimes reddish or purplish stems near the base, with translucent margins; ligule to 1 mm long, truncate, finely hair-fringed; collar continuous, distinct, yellowish green; auricles rudimentary, often only one.

Seed

A. trachycaulum: 12-15 mm long, awnless or awn-tipped.
A. violaceum: 10-12 mm long and less involute than *A. trachycaulum.*

Habitat

Prairies and woodland openings of the aspen parkland on moist, well-drained soils; requires 35 cm of annual precipitation; well-adapted to low areas having saline soils.
A. violaceum is a sub-alpine and arctic species.

Association(s)

A component of many grassland communities.

Distribution

In Western Canada, *A. trachycaulum* is found more frequently in northern and eastern portion of the Prairies; Alas, Yuk, sMack to Huds Bay, Nfld south to Calif, Ariz, Ia, and Gt Lakes.
A. violaceum: Alas, Yuk to Ellesmere Is. south to Wash, Colo, sMack, Huds Bay, and Lab; Greenland.

Phenology

Short-lived, cool-season perennial.
A. trachycaulum: starts growth early in spring; requires 95-110 days from emergence to seeds ripening in mid to late July; at higher elevations, seed matures by late August to mid September. *A. violaceum:* starts growth very early in the spring or as adjacent snow banks melt; seed matures by mid August in natural stands.

Genetics

2n = 28. *A. trachycaulum* can hybridize with *Hordeum jubatum* (wild barley) and *Elymus innovatus* (hairy wild rye). *A. violaceum* can hybridize with *A. scribneri.*

Pollination

Wind; self-pollinating.

Seeding Methods

Row spacings of 30-90 cm (12-36") recommended; narrow row spacings of 30-60 cm (12-24") suitable for the Black and Grey Wooded Soil Zones of Western Canada; best seeded in spring; seed carrier recommended for seeding *A. violaceum.*

Seed Weight

A. trachycaulum: 290,000-350,000 seeds/kg (130,000-159,000 seeds/lb); *A. violaceum:* 244,000 seeds/kg (110,900 seeds/lb)

Seeding Rate

82-98 seeds/linear m of row (25-30 seeds/linear ft)

Seeding Depth

1.2-1.8 cm (½-¾")

Seed Germination
95% in 6-14 days.
Stand Establishment
Excellent. *A. violaceum* is slower to establish and not as competitive as *A. trachycaulum.*

Harvest Methods

Expect first significant seed crop in the second year. Direct combine at the mature seed stage or swath at the hard dough stage when seed heads reach 40-45% moisture content. *A. violaceum* usually produces two flushes of seed heads per year, however only one (usually the first) is worth harvesting; harvest heads of *A. violaceum* when heads and stems are a greenish white.
Harvest Dates
A. trachycaulum: mid July
*A. violaceum:*1-3 weeks earlier
Shattering Potential
High



broad-glumed wheat grass

Cylinder Speed
1000-1200 rpm
Concave Spacing
0.9-1.2 cm (⅜- ½")
Expected Seed Yield
A. trachycaulum:
400-900 kg/ha
(357-820 lb/ac)
A. violaceum:
150-350 kg/ha
(134-312 lb/ac)
Stand Life
3-4 years

Seed Processing

Debearding
Not required; may improve seed flow
Cleaning
Top screen: ¼ x ½" slotted
Bottom screen: 6 x 18 mesh

Culture

Plants have a short life span (approx. 5 years). Seed yield is usually high for two production years. Tolerance to head smut varies; can be a problem in some cultivars/ populations of *A. trachycaulum.*

Reclamation Role

A. trachycaulum is used extensively across Canada and in the northern United States. An alkaline, somewhat drought tolerant species, often included in reclamation seed mixes as a nurse crop with slower establishing but longer-lived grasses. *A. violaceum* is an important species for high-altitude land reclamation.

Forage Notes

A. trachycaulum: Palatable and nutritious at all stages; seed heads readily eaten by livestock in the fall; moderately used by Rocky Mountain elk in fall; cures on stem; average protein levels 23% in May, dropping to 8-10% in the fall. Used as a hay crop under short-term rotation in moister regions of Canada.
Grazing Response
Decreaser
Livestock Forage Value
Good
Wild Ungulate Forage Value
Good



seeds: broad-glumed wheat grass (left) and slender wheat grass (right) (x 1.1)

Cultivars

Canadian
A. trachycaulum: Adanac (Saskatoon, Sask), Highlander (Vegreville, Alta), and Revenue (Lethbridge, Alta);
A. violaceum: Mountaineer (Vegreville, Alta)
Other
A. trachycaulum: Primar (Mont), Pryor (Mont), San Luis (Colo);
A. violaceum: none

Bouteloua gracilis (H.B.K.) Lag.



blue grama

Plant

Densely-tufted perennial, 20-50 cm tall with occasional, short rhizomes; surface roots to 50 cm; feeder roots to 1 m. Plants produces a dense mat of short, often twisted leaves. Pith-filled stems bear 1-3 comb-like spikes; spikes 1.5-4 cm long, often bluish-purple; spikelets with one perfect flower; fertile lemma with soft spreading hairs; rudimentary lemma densely bearded-hairy.

Vegetative Characteristics

Leaves to 3 mm wide, light to medium green, flat to tube-like, curled, sometimes hairy on upper surface especially near base; veins prominent on both surfaces; rolled at emergence; sheath round, split, distinctly veined, sometimes sparsely hairy, with translucent margins; ligule to 0.5 mm long, a dense fringe of hairs; collar continuous, distinctly yellowish green, with long hairs on inside of margins; auricles absent.

Seed

3-4 mm long; lemma hairy.

Habitat

Dry grasslands; thin-soiled upland sites.

Association(s)

Stipa comata, Koeleria macrantha and *Agropyron smithii.* Also found on sandy sites with *Calamovilfa longifolia*, and on dry sites with *Carex stenophylla* (low sedge).

Distribution

In Canada, *B. gracilis* is a characteristic species of the dry mix-grass prairie, becoming less common north to the tree line; BC to sMan south to Calif, Tex, Mo, and Ill; SAm.

Phenology

Long-lived, warm-season perennial; starts growth late in the spring (beginning of May in south portion of the Prairie provinces; up to two weeks later in the central region); requires 75 days from emergence to seed maturity.

Genetics

2n = 20, 21, 28, 35, 42, 61, 77, 84

Pollination

Wind; cross-pollinating.

Seeding Methods

Row cropping recommended; 60-103 cm (24-42") row spacing; however, row spacing as narrow as 30 cm (12") can be used; seed in late spring once soils have warmed up or in early summer; fall seeding not recommended; best seeded with a seed carrier.

Seed Weight

1,820,000 seeds/kg (827,300 seeds/lb)

Seeding Rate

98-131 seeds/linear m of row (30-40 seeds/linear ft)

Seeding Depth

0.6-1.3 cm (¼- ½")

Seed Germination

70% in 5-10 days; dehulling seeds improves germination in dormant seed lots.

Stand Establishment
Not very competitive during establishment; needs moist, warm soil for germination and again several weeks later for development of permanent adventitious roots.

Harvest Methods

Expect first seed crop in the second year. Direct combine at the hard dough to mature seed stage or swath at the medium to hard dough stage; direct combining preferred; reduce air intake when combining.

Harvest Dates
Late August to September



blue grama mat

Shattering Potential
Low
Cylinder Speed
1200 rpm
Concave Spacing
0.2-0.5 cm (1/16 - 3/16")
Expected Seed Yield
84-168 kg/ha (75-150 lb/ac)
Stand Life
8 years

Seed Processing

Debearding
Required to remove hairs
Scalping
May be required
Cleaning
Top screen: 3/4" round
Bottom screen: 18 x 20 mesh

Reclamation Role

An active colonizer of thin soils on disturbed sites; effective for erosion control; suitable for revegetating poor, dry soils.

Forage Notes

Cures on stem; average protein levels dropping to 5% by fall; rarely grazed by livestock in mid-summer but readily eaten during fall and early winter; not a highly productive species but digestibility is good. Aggressive increaser under heavy grazing.

Grazing Response
Increaser
Livestock Forage Value
Good
Wild Ungulate Forage Value
Good



seeds (x 1.1)

Cultivars

Canadian
None
Other
Bad River (ND)

Bromus ciliatus L.

Synonym(s): *Bromus richardsonii* Link



fringed brome

Plant

A loosely-tufted perennial 60-100 cm tall. Seed heads are loose, open, often drooping panicles, 10-20 cm in length; spikelets large, 4-10 flowered; glumes shorter than the adjacent lemma.

Vegetative Characteristics

Leaves to 10 mm wide, dark green, flat, sometimes softly hairy, veins prominent on both surfaces, with whitish mid-vein on lower side extending part way down sheath, rolled at emergence; margins rough; sheath round, closed, forming a tube, distinctly veined, usually hairy; culm nodes often with short hairs; ligule to 1 mm long, blunt to rounded, entire or lacerate; collar divided, pale green or brownish; auricles absent.

Seed

8-11 mm long; lemma more or less hairy; awn to 5 mm long arising between two teeth at tip of lemma; palea adheres to grain.

Habitat

Open deciduous and coniferous woods and meadows; moist areas at the perimeter of the prairie and at elevated sites below the tree line; requires 40 cm annual precipitation.

Distribution

Alas, Yuk, swMack to James Bay, Nfld south to Calif, Ariz, NM, Tex, Neb, Gt Lakes, and Apal.

Phenology

Cool-season perennial; starts spring growth in mid May; seeds mature by mid August.

Genetics

2n = 14, 28

Pollination

Wind; presumed out-crosser.

Seeding Methods

Row spacings of 30-90 cm (12-36") recommended; narrow row spacings of 30-60 cm (12-24") suitable for the Black and Grey Wooded Soil Zones of Western Canada; best seeded in early spring; use a seed carrier.

Seed Weight

300,000 seeds/kg (136,400 seeds/lb)

Seeding Rate

98-131 seeds/linear m of row (30-40 seeds/linear ft)

Seeding Depth

0.6-1.2 cm (¼-¾")

Seed Germination

85% in 10-15 days.

Stand Establishment

Good.

Harvest Methods

Expect first seed crop in the second year. Direct combining recommended at the hard dough to mature seed stage.

Harvest Dates

Early to mid August

Shattering Potential

High

Cylinder Speed
850-1000 rpm
Concave Spacing
0.3-0.9 cm (⅛- ⅜")
Expected Seed Yield
250-500 kg/ha (230-450 lb/ac)
Stand Life
4 years

Seed Processing

Debearding
To remove hairs and improve seed flow
Cleaning
Top screen: ¾" round
Bottom screen: ⅛" round

Culture

Lodging may be a problem if over fertilized.

Reclamation Role

Effective for erosion control; suitable for revegetating disturbances in the foothills and boreal forests.



seedling - 23 days

Forage Notes

Excellent forage species for both wild ungulates and livestock; palatable from emergence to maturity; average protein levels from 20% in early June dropping to 9% by July and to 3% by October; digestible carbohydrate content increases as the season progresses until August; does not cure on the stem.
Grazing Response
Decreaser
Livestock Forage Value
Good
Wild Ungulate Forage Value
Good



seeds (x 1.4)

Cultivars

Canadian
None, but seed from Alberta stock is commercially available.
Other
None

Calamovilfa longifolia (Hook.) Scribn.



sand reed grass

Plant
A coarse, loosely-tufted perennial, 50-180 cm tall with long, scaly, yellowish rhizomes; deep roots to 1.5 m; old leaf sheaths surround the base; panicles 10-35 cm long, with branches ascending and often appressed, contracted at maturity; spikelets one-flowered with rigid glumes.

Vegetative Characteristics
Leaves to 12 mm wide, light green, flat to rolled inward, firm, leathery, smooth on both surfaces, rolled at emergence, not prominently veined; margins rough; sheath round, split, with overlapping translucent margins, distinctly veined, light green, sometimes pinkish at the base; ligule to 3 mm long, a fringe of hairs; collar distinct, continuous, yellowish, with tufts of fine hairs on inner margins; auricles absent.

Seed
4-7 mm long, with a callus bearing copious hairs more than half as long as the lemma.

Habitat
Sandy prairie, open forests, and sand dunes; requires 30 cm annual precipitation.

Association(s)
Sporobolus crytandrus (sand drop seed) and *Oryzopsis hymenoides* (Indian rice grass).

Distribution
Across the Great Plains; sBC to wOnt south to nIda, Colo, Mo, and Mex.

Phenology
Long-lived, warm-season perennial; starts growth in late spring; seeds mature by late August to early September.

Genetics
2n = 40, 60

Pollination
Wind; cross-pollinating.

Seeding Methods
Row cropping recommended; 60-90 cm (24-36") row spacing; seed in mid to late spring; fall seeding not recommended.

Seed Weight
600,000 seeds/kg (272,700 seeds/lb)

Seeding Rate
82-98 seeds/linear m of row (25-30 seeds/linear ft)

Seeding Depth
1.2-2.4 cm (½- 1")

Seed Germination
92% in 5-12 days.

Stand Establishment
Good.

Harvest Methods
Expect first seed crop in second year. Direct combine at the hard dough to mature seed stage or swath at the medium to hard dough stage; when direct combining, cut high to reduce trash; tough straw may cause plugging.

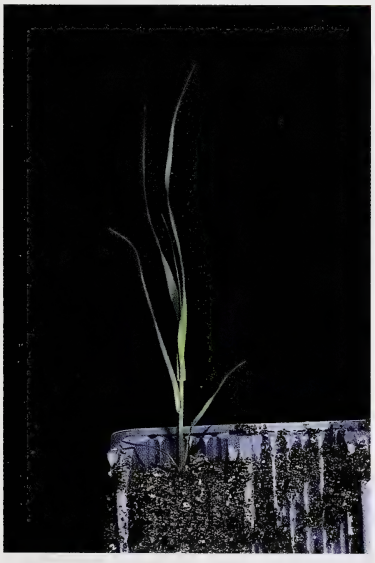
Harvest Dates
Late August to early September

Shattering Potential
High

Cylinder Speed
900-1200 rpm
Concave Spacing
1.0 cm (⅜")
Expected Seed Yield
90-360 kg/ha (100-400 lb/ac)
Stand Life
6-10 years

Seed Processing

Debearding
Required to remove callus hairs
Scalping
Often required
Cleaning
Top screen: ¾" round
Bottom screen: ⅕" round



seedling - 1 month

Culture

Cultivate between rows in spring or fall. Leaf and stem rust may be a problem under irrigation. Stands are usually burned after harvest or in early spring.

Reclamation Role

An important species for stabilization of sandy soils.



seeds (x 1.1)

Forage Notes

Cures on stem; palatable during the first month of growth and after it cures on the stem in the fall; both leaves and seeds are readily eaten but stems are generally avoided; provides good winter pasture; average protein levels from 16% in spring to 4% in November; does not tolerate trampling.
Grazing Response
Decreaser
Livestock Forage Value
Fair
Wild Ungulate Forage Value
Fair

Cultivars

Canadian
None
Other
Bowman (ND), Goshen (Wyo), Pronghorn (Neb)

Deschampsia cespitosa (L.) Beauv.



tufted hair grass

Plant

A densely-tufted perennial, 20-120 cm tall with shallow roots and a mass of deep green leaves covering crowns. Seed heads loose, open, often nodding panicles, 10-25 cm in length; spikelets mostly 2-flowered.

Vegetative Characteristics

Leaves to 5 mm wide, flat, folded or bristle-like, flexuous, prominently ridged, rough above, translucent between the veins; light green, rough margined, folded at emergence; sheath compressed, keeled, split, prominently veined, light green to straw coloured, margins overlapping and translucent; ligule to 10 mm long, very prominent, entire or sometimes split, sharp-pointed, continuous; collar narrow, divided, sometimes indistinct, yellowish green or brownish, with noticeable swellings at each end; auricles absent.

Seed

2.5-3.5 mm long, with a callus bearing short hairs; awn 2.5-3.5 mm long arising from near the base of the lemma.

Habitat

Sloughs, moist draws, wet meadows and on stream banks; poorly-drained, rather fertile soils; tolerant to both acid and alkaline conditions; also on dry sites at high elevations.

Association(s)

Widely occurring species that forms associations with numerous species within its range.

Distribution

Across Canada; Alas to Ellesmere Is., south to Calif, Ariz, NM, SD, Gt Lakes, and Apal; circumpolar.

Phenology

Short-lived, cool-season perennial; starts growth early in spring; seeds matures from late June to mid July.

Genetics

2n = 26, (27, 28)

Pollination

Wind; cross-pollinating.

Seeding Methods

Broadcast or plant in spaced rows, 15-60 cm (6-30"); seed in early spring; a seed carrier is recommended.

Seed Weight

3,600,000 seeds/kg (1,636,400 seeds/lb)

Seeding Rate

164-246 seeds/linear m of row (50-75 seeds/linear ft)
Broadcast at 6.5-9 kg/ha (6-8 lb/ac)

Seeding Depth

0.6-1.2 cm (¼")

Seed Germination

88% in 7-28 days.

Stand Establishment

Fair to good with adequate moisture; seeding depth critical; not highly competitive.

Harvest Methods

Expect first seed crop in the second year. Direct combine at the mature seed stage; tips of seed heads will be just beginning to shatter; swathing not recommended; shut off air intake when combining.

Harvest Date
Late June to early July

Shattering Potential
High

Cylinder Speed
850-1000 rpm

Concave Spacing
0.2-0.3 cm (1/16 - 1/8")

Expected Seed Yield
20-45 kg/ha (18-40 lb/ac)

Stand Life
5 years



seedling - 1 month

Seed Processing

Debearding
Not required

Cleaning
Top screen: 1/5" round
Bottom screen: 40 x 40 mesh
- shut off air intake

Culture

Best grown in moister regions or under irrigation.

Reclamation Role

A highly variable species that is adapted to various high-stress environments; often recommended in reclamation seed mixes; dominant colonizer of both calcareous mine waste and acid soils; tolerant of heavy metal contamination. *D. cespitosa* var. *mackenziana* Raup has shown promise in the reclamation of oil sand tailings.

Forage Notes

Highly palatable species that is resistant to grazing; protein content 18% in May decreasing to 7% by August; phosphorus levels above average; heavily used in summer by Rocky Mountain elk and occasionally by mule deer.

Grazing Response
Decreaser

Livestock Forage Value
Good

Wild Ungulate Forage Value
Good

Cultivars

Canadian
None

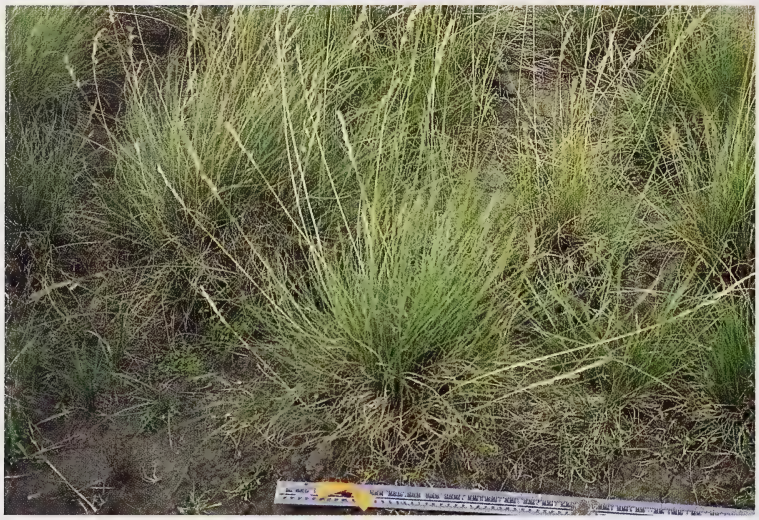
Other
Peru Creek (Colo)



seeds (x 1.6)

Festuca hallii (Vasey) Piper /*F. campestris* Rydb. /*F. altaica* Trin. *ex* Lebed.

Synonym(s): These species are closely related and together form the rough fescue complex (*F. scabrella* Torr.)



plains rough fescue

Plant

More or less densely-tufted with rough-textured leaves and persistent leaf sheaths; stem nodes usually not visible; lemmas with short awns.
F. hallii: 20-85 cm tall, with short rhizomes, grey-green leaves, lustrous stems, and diffused purple sheaths; panicles erect; spikelets with 2 fertile flowers; upper glumes about equal in length to adjacent lemma. *F. altaica*: densely-tufted, 30-60 cm tall with very short rhizomes; leaves green; panicles drooping at maturity; glumes distinctly shorter than adjacent lemma; spikelets 3-4 flowers; lemmas often reddish to purplish. *F. campestris:* stout tussocks, 40-120 cm tall with leaf blades that commonly breaks off at the collar; panicles erect; glumes distinctly longer than adjacent lemma; spikelets 4-5 flowered.

Vegetative Characteristics

F. hallii: leaves to 1.5 mm wide, permanently folded, ridged, rough on both surfaces and margins; sheath round, split, ridged; ligule to 0.5 mm, lacerate, hair-fringed; collar indistinct, yellowish; auricles absent.
F. campestris: leaves to 4 mm wide, flat to folded; collar distinct, very narrow, yellowish; auricles rudimentary.

Seed

Lemma rounded with a 0.5-1.3 mm awn.
F. hallii: 7-8 mm long;
F. campestris: slightly larger seeds to 9 mm long.
F. altaica: 6-8 mm long with a shorter awn (0.2-0.7 mm long).

Habitat

Where annual precipitation is greater than 35 cm; dominant in transitional zones between dry prairie and areas dominated by woody species.
F. hallii: moist prairie; grassy openings in the aspen parkland; prefers medium to heavy-textured soils. *F. campestris*: cool, moist grasslands of the foothills and montane regions. *F. altaica*: a wide variety of habitats from gravel outwashes and serpentine barrens to open pine forest and meadows in the northern sub-alpine and arctic.

Association(s)

F. hallii: Stipa curtiseta in the northern Canadian prairies and aspen parkland. *F. campestris: Danthonia parryi* (Parry oatgrass) in montane grasslands of the Rocky Mountains.

Distribution

Dominant species in their respective ecoregions. *F. hallii:* the central to northern part of the Canadian prairies and the aspen parkland; Alta to sMan south to Mont and SD.
F. campestris: montane grasslands of the Canadian Rocky Mountains; also the Cypress Hills; sBC to sMan south to Ore, Ida, Mont, Colo, ND, and north along the Canadian Rocky Mountains to James River, Alta.
F. altaica: northern boreal forest; Alask east to Que (Gaspé) and Nfld, south along the Canadian Rocky Mountains to Jasper, Alta.

Phenology

Long-lived, cool-season perennial; growth starts early in spring; seeds mature by mid to late July. *F. hallii:* flowers 2-3 weeks earlier (mid-June) than *F. campestris* but seeds mature later. Mass flowering in natural stands of both *F. hallii* and *F. campestris* has been noted in some years followed by years with relatively little seed head production.

Genetics

F. hallii 2n = 28; *F. campestris* 2n = 56; *F. altaica* 2n = 28. These species may hybridize with each other.

Pollination

Wind; cross-pollinating.

Seeding Methods

Row spacing of 40-90 cm (16-36") recommended; row spacing of

40-60 cm (16-24") recommended for the Black and Grey Wooded Soil Zones of Western Canada; seed in early spring.

Seed Weight
F. hallii 886,000 seeds/kg (402,700 seeds/lb);
F. campestris 600,000 seeds/kg (272,700 seeds/lb);
F. altaica 654,000 seeds/kg (297,300 seeds/lb).

Seeding Rate
131-164 seeds/linear m of row (40-75 seeds/linear ft)

Seeding Depth
1.2 cm (½")

Seed Germination
78% in 6-12 days.

Stand Establishment
Emergence is poor despite relatively high germination rates; high soil moisture needed for adequate emergence. Stand development is slow requiring at least two full seasons.



juvenile plains rough fescue

Harvest Methods

Expect first significant seed crop in the third year. Direct combine at the hard dough to mature seed stage; swathing not recommended.

Harvest Dates
Early to mid July

Shattering Potential
High

Cylinder Speed
1000-1200 rpm

Concave Spacing
0.9-1.2 cm (⅜- ½")

Expected Seed Yield
F. hallii: 150-450 kg/ha (134-400 lb/ac) in the first full production year (third to fifth year); dropping severely thereafter to 25-75 kg/ha (22-67 lb/ac).

Stand Life
5 years

Seed Processing

Debearding
Not required

Cleaning
Top screen: ¾" round
Bottom screen: ⅛" round

Culture

Seed yield values based on a limited number of field years. Seed production can vary dramatically from year to year.

Reclamation Role

Fescue grassland was the principal vegetation of the Black Soil Zone, the most productive soil zone in western Canada. Consequently, much of these grasslands have been lost to cultivation since the turn of the century. Interest in these species lies in their use in restoration efforts and range rehabilitation. *F. altaica* appears to be a highly variable species whose potential for reclamation has not been fully assessed.



seeds: mountain rough fescue (left), plains rough fescue (centre) and northern rough fescue (right) (x 1.1)

Forage Notes

Very productive native forage; cures on stem most years except in years of early frost; very palatable; easily grazed out; spring protein is 12% increasing by June and dropping to 4-5% by fall. Quality of forage appears to be somewhat variable from region to region. Rough fescue is a major component of bighorn sheep diet in summer and is used heavily by elk in winter and spring. Does not tolerant continuous grazing nor heavy grazing in early spring.

Grazing Response
Decreaser

Livestock Forage Value
Good

Wild Ungulate Forage Value
Good

Cultivars

Canadian
None, but local, wild-harvest seed is commercially available.

Other
None

Festuca idahoensis Elmer



Idaho fescue

Plant
A densely-tufted perennial to 100 cm tall, with glaucous-blue appearance, very fine leaves, and persistent sheaths. Seed heads are narrow panicles, 10-20 cm long, ascending to appressed; glumes shorter than the first lemma; spikelets 5-7 flowered.

Vegetative Characteristics
Leaves to 2 mm wide, bluish green, mainly basal, folded to thread-like, extremely erect, stiff, with indistinct veins, folded at emergence; sheath flattened, keeled, split only part way, pinkish at the base; ligule to 1 mm long, truncate, hairy-fringed, with two lateral lobes; auricles position with small erect swelling.

Seed
6-8 mm long, almost round in cross section, with short awn to 5 mm.

Habitat
Open pine and poplar forests; exposed bench lands in meadows at elevations between 900 and 2100 m; best suited to deep, fertile, silt and clay soils; resistant to grazing and trampling.

Associations
F. campestris and *Agropyron spicatum* (bluebunch wheatgrass).

Distribution
Mont, north through the foothills of the Rocky Mountains, east along the Milk River Ridge and into Cypress Hills, south to Calif and Colo.

Phenology
Cool-season perennial; starts growth in early spring; seed matures mid to late July.

Genetics
2n = 28

Pollination
Wind; cross-pollinating.

Seeding Methods
Row spacings of 40-90 cm (16-36") recommended; narrow rows 40-60 cm (16-24") recommended for the Black and Grey Wooded Soil Zones of Western Canada; seed in early spring.

Seed Weight
952,400 seeds/kg (432,900 seeds/kg)

Seeding Rate
131-246 seeds/linear m of row (40-75 seeds/linear ft)

Seeding Depth
0.6-1.2 cm (¼- ½")

Seed Germination
80% in 6-12 days.

Stand Establishment
Emergence is only fair despite relatively high germination rates; stand development is slow requiring two full seasons.

Harvest Methods
Expect first seed crop in the third year. Direct combine at the hard dough to mature seed stage or swath at the hard dough stage.

Harvest Dates
Mid July

Shattering Potential
Moderate

Cylinder Speed
1200-1400 rpm

Concave Spacing
0.9-1.2 cm (⅜- ½")

Expected Seed Yield
145 kg/ha (130 lb/ac)

Stand Life
5 years

Seed Processing

Debearding

Required; strongly awned; also used to break up doubles.

Cleaning

Top screen: ¾" round
Bottom screen: 20 x 20 mesh

Reclamation Role

Recommended for range rehabilitation.



seedling - 1 month

Forage Notes

One of the most palatable forages in the association where it grows. Protein levels high in the spring but decreases as summer advances; readily grazed by livestock in the fall; heavily used in winter by elk and mule deer, and by elk in spring.

Grazing Response

Increaser

Livestock Forage Value

Good

Wild Ungulate Forage Value

Good

Cultivars

Canadian

None

Other

None



seeds (x 1.1)

Festuca saximontana Rydb. /*F. brachyphylla* Schultes

Synonym(s): *F. ovina* var. *saximontana* (Rydb.) Gleason; *F. ovina* var. *brachyphylla* (Schultes & Schultes fil) Piper. Both *F. saximontana* and *F. brachyphylla* are closely related to the European sheep fescue (*Festuca ovina* L. *sensu stricto*) and are included in the group known as the sheep fescue complex.



alpine fescue

Plant

F. saximontana: densely-tufted perennials, 10-60 cm tall with persistent sheaths and very fine leaves; panicles 2-8 cm long, yellowish-green to rarely purple, contracted; spikelets 2-5 flowered; glumes shorter than first lemma; anthers 1-1.5 mm long.
F. brachyphylla: shorter, 10-40 cm tall; compact panicles, 1-3 cm long, often dark purple, sometimes glaucous and bronze-edged; spikelets 3-4 flowered; anthers 0.6-1.0 mm long.

Vegetative Characteristics

Leaves 0.5-1.0 mm wide, bluish grey to bright green, mainly basal, rolled inward to thread-like, rough and ridged, folded at emergence; margins smooth; sheath round, partially split, with translucent margins; ligule to 0.5 mm long (to 0.3 mm in *F. brachyphylla*), and finely hair-fringed; collar indistinct, narrow; auricles positions showing erect swellings.

Seed

Lemmas rounded on the back with a short awn to 3 mm; palea distinctly hairy at the apex between keels;
F. saximontana: 3-6 mm long;
F. brachyphylla: 3-4 mm long.

Habitat

F. saximontana: grasslands, dry hillsides, open woods, sandy soils in the moister regions of the prairie, and exposed sites in the Rocky Mountains up to the tree line.
F. brachyphylla: an alpine and arctic species.

Distribution

F. saximontana: Alas, Yuk, sMack to James Bay, nQue, Nfld south to BC, Colo, sSask, sMan, Gt Lakes, and sQue. *F. brachyphylla:* Alas to Ellesmere Is. to Calif, NM north to Sask, James Bay, and eQue (Gaspé); Eurasia; circumpolar.

Phenology

Both are cool-season perennials; growth starts very early in spring or as adjacent snow banks melt and recede. Flowering and seed maturity highly variable in natural stands depending on elevation, latitude, and factors affecting micro-site variability; seed matures on the Prairies by mid June to early July and by early to late August at higher elevations.

Genetics

2n = 42

Pollination

Wind; cross-pollinating.

Seeding Methods

Use narrow row spacings, 20-50 cm (8-20"); row cropping not recommended; seed in early spring.

Seed Weight

F. saximontana: 1,041,700 seeds/kg (473,500 seeds/lb);
F. brachyphylla: 1,111,100 seeds/kg (505,000 seeds/lb)

Seeding Rate
131-246 seeds/linear m of row (50-75 seeds/linear ft)
Seeding Depth
0.6-1.2 cm (¼- ½")
Seed Germination
94% in 6-14 days.
Stand Establishment
Good.

Harvest Methods

Expect first seed crop in the second year. Direct combine at the hard dough to mature seed stage or swath at the hard dough stage.
Shattering Potential
Moderate



Rocky Mountain fescue seed production field

Harvest Date
Mid to late June
Cylinder Speed
1200-1400 rpm
Concave Spacing
0.3-1.0 cm (⅛- ⅜")
Expected Seed Yield
300-450 kg/ha (268-400 lb/ac)
Stand Life
5 years

Seed Processing

Debearding
Not required
Cleaning
Top screen: 5½/64" round
Bottom screen: 20 x 20 mesh

Culture

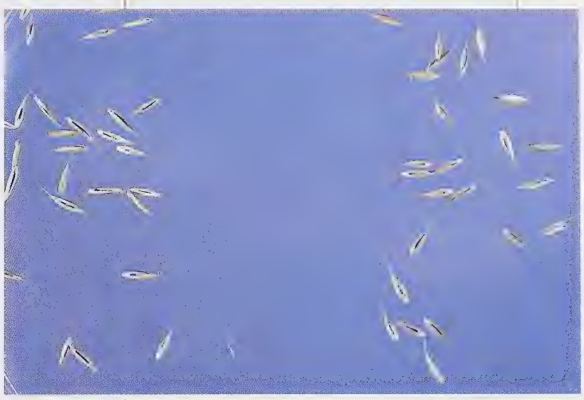
A drought tolerant species. To renovate stands, lightly mow after harvesting and remove straw.

Reclamation Role

Pioneer species of high-stress environments; often recommended in reclamation seed mixes. *F. saximontana:* suitable for reclamation of high-altitude disturbances, erosion control on sandy or gravelly soils, and restoration of Rocky Mountain sheep habitat. *F. brachyphylla:* suitable for reclaiming disturbances in alpine and arctic regions.

Forage Notes

Less palatable than *F. idahoensis* but readily sought by Rocky Mountain sheep and is heavily used by elk in spring and summer; stays green and succulent until late fall but overall forage production is low.



seeds: Rocky Mountain fescue (left) and alpine fescue (right) (x 1.1)

Grazing Response
Increaser
Livestock Forage Value
Fair
Wild Ungulate Forage Value
Good

Cultivars

Canadian
None, but seed from Alberta seed stock is commercially available.
Other
None

Hierochloe odorata (L.) Beauv.



sweet grass

Plant

Sod-forming perennial, 30-60 cm tall with shallow roots and aggressive, slender rhizomes. Seed heads somewhat compacted to loose panicles, 4-12 cm long, pyramidal with spreading to reflexed branches; spikelets tan, bronze, or purple; glumes broad, boat-shaped, very thin and shiny, enclosing one perfect flower and two staminate flowers giving rise to a single seed. Entire plant gives off a distinctive sweet odour.

Vegetative Characteristics

Leaves to 8 mm wide, dark green, flat to tube-like, with fine prominent veins on both sides, rolled at emergence; midrib white below; margins rough; sheath round, split, and distinctly veined; ligule to 3 mm long, blunt or rounded, toothed, lacerate, sometimes hair-fringed; collar divided, narrow; auricles absent; young shoots purplish at the base.

Seed

4 mm long, brownish, with appressed-hairs at apex.

Habitat

Moist to dry open places; low-lying uplands and draws, abandoned fields; also found on sandy soils in the moister part of its range.

Distribution

Alas, Yuk, Mack to Huds Bays, nQue, Nfld, s to Ore, Nev, Ariz, SD, Gt Lakes, and Mexico; Eurasia; circumpolar.

Phenology

Perennial; flowers in the spring and matures seed by mid June to early July (later on moister sites); top portion of plant may wither after seed drop. Seed set in wild populations poor with many partially filled seeds.

Genetics

2n = 28, 42, 56

Pollination

Wind; cross-pollinating.

Seeding Methods

Row spacing of 30-90 cm (12-36") recommended; seed in late summer or fall; seed carrier recommended.

Seed Weight

1,667,000 seeds/kg
(757,700 seeds/lb)

Seeding Rate

328 seeds/linear m of row
(100 seeds/linear ft), based on TZ.

Seeding Depth

0.6-1.2 cm (¼- ½")

Seed Germination

5% in 21 days with pretreatment. Pretreatment(s) for dormant seed lots: stratification

Vegetative Propagation

By rhizomes.

Stand Establishment

Poor; seed dormancy and viability is a major problem in this species. Sprigging may be the best way to establish stands.

Harvest Methods

Direct combine at the mature seed stage.

Harvest Dates
Late June to early July
Shattering Potential
Low
Cylinder Speed
1000-1200 rpm
Concave Spacing
0.2-1.0 cm (1/16 - 3/8")

Seed Processing

Debearding
Not required
Cleaning
Top screen: 3/4" round
Bottom screen: 20 x 20 mesh

Culture

Older stands may become sod-bound.



seedling - 3 weeks

Reclamation Role

An effective reclamation species for controlling water erosion on moister sites. Specific populations may also be suitable for stabilizing sandy areas with underlying water tables.



seeds (x 1.1)

Forage Notes

Eaten fairly readily by cattle but not as palatable as most range grasses; not very palatable for wild ungulates or horses; bitter taste due to coumarin content.
Grazing Response
Increaser
Livestock Forage Value
Fair
Wild Ungulate Forage Value
Poor

Cultivars

Canadian
None
Other
None

Koeleria macrantha (Ledeb.) J.A. Schultes f.

Synonym(s): *K. cristata* (L.) Pers. (in part), *K. gracilis* Pers., *K. nitida* Nutt.



June grass

Plant

Small, densely-tufted perennial 10-60 cm tall with roots to 50 cm; few feeder roots to 75 cm. The seed head is a dense, spike-like panicle, 3-10 cm long, often interrupted below. Spikelets usually 2-flowered (4), pale green or purple. This species is variable in appearance; plants of the dry prairie are short with more basal leaves.

Vegetative Characteristics

Leaves to 4 mm wide, mainly basal, flat to rolled inward, bluish green, distinctly ribbed and rough, folded at emergence, with lower surface keeled; margins rough and translucent; sheath round, split, and distinctly veined; ligule to 1 mm long, blunt or rounded, often split, usually hair-fringed; collar medium broad, yellowish-green, continuous or divided; auricles absent. Whole plant may or may not be hairy to varying degrees.

Seed

3-4 mm long; lemma rounded on the back, lustrous, usually short-awned arising from just below apex.

Habitat

Grasslands; forest openings in the northern boreal forest; prevalent on light calcareous soils.

Association(s)

Bouteloua gracilis and *Stipa comata* in mixed-grass prairie; *Festuca hallii* or *F campestris* in fescue grasslands; *Elymus innovatus* (hairy wild rye) and *Calamagrostis* spp. (reed grasses) in forest openings; *Andropogon scoparius* (little bluestem) in the Interlake area of Manitoba; and, *Agropyron-Poa* communities of sBC.

Distribution

One of the most common species on the Canadian Prairie; BC, sMack to sOnt, sQue, Me south to Calif, Tex, La; and sYuk; Eurasia; circumpolar.

Phenology

Long-lived perennial; starts growth very early in spring; seed matures by late July or early August within 75-80 days after spring emergence; seldom grows in dense stands.

Genetics

2n = 14, 28

Pollination

Wind; cross-pollinating.

Seeding Methods

Row spacings of 20-90 cm (8-36") recommended; narrow rows from 20-60 cm (8-24") recommended for the Black and Grey Wooded Soil Zone of Western Canada; seeds may also be broadcast; seed in early spring; use a seed carrier.

Seed Weight

3,448,000 seeds/kg (1,567,300 seeds/lb)

Seeding Rate

131-246 seeds/linear m of row (40-75 seeds/linear ft)

Seeding Depth
0.6 cm (¼")
Seed Germination
99% in 6-10 days; populations may vary; seed often of low viability (approx. 40%).
Stand Establishment
Good to fair depending on population; seeding depth critical.

Harvest Methods

Expect first seed crop in the second year. Direct combine at the mature seed stage or swath at the hard dough stage; swathing preferred; shut off air intake when combining.
Harvest Dates
Late July



juvenile June grass

Shattering Potential
Moderate to low
Cylinder Speed
1000-1200 rpm
Concave Spacing
0.3-1.0 cm (⅛ - ⅜")
Expected Seed Yield
80-150 kg/ha (70-134 lb/ac)
Stand Life
5 years

Seed Processing

Debearding
Not required
Cleaning
Top screen:
⅕" round
Bottom screen: 20 x 20 mesh
- reduce air intake

Reclamation Role

An early pioneer on disturbed sites; recommended in many native seed mixes.

Forage Notes

Cures on stem; spring protein levels 20% dropping to 4% in November; highly palatable in spring and after curing in the fall but rarely eaten during the summer by livestock; moderately used by deer and elk in spring and summer.
Grazing Response
Increaser
Livestock Forage Value
Good
Wild Ungulate Forage Value
Good

Cultivars

Canadian
None; but common seed is commercially available.
Other
None



seeds (x 1.6)

Poa alpina L.



alpine bluegrass

Plant

Small, densely-tufted perennial 10-50 cm tall with shallow, dense roots. Seed heads are open or compacted panicles, 2-8 cm long, pyramidal or ovoid in shape with spreading branches; lower branches reflexed; spikelets flattened, often heart-shaped at base; glumes keeled, awned-tipped, often with purple margins.

Vegetative Characteristics

Leaves 2-7 mm wide, mainly basal, bluish-green, smooth, flat to slightly folded, with boat-shaped tips, prominently veined, with whitish mid-vein on upper surface and keel on lower, folded at emergence; sheath split, prominently veined with translucent margins, pale-tawny at base; ligule to 4 mm, entire to lacerate, blunt to rounded; collar yellowish, conspicuous; auricles absent.

Seed

3-4 mm long; lemmas keeled, hairy along the keel and marginal nerves but not cobwebby at base.

Habitat

Alpine, sub-alpine, and arctic meadows, descending to montane areas; rocky slopes and shores, calcareous ridges, and high-altitude disturbances; requires at least 38 cm annual precipitation.

Distribution

Alas, Yuk to Baffin Is. south to Ore, Utah, Colo, sMack, nSask, sMan, Gt Lakes, and Nfld; circumpolar.

Phenology

Cool-season perennial; starts growth very early in spring or as adjacent snow banks melt and recede; flowering and seed maturity highly variable in natural stands depending on elevation, latitude, and factors affecting micro-site variability.

Genetics

2n = 14, 21, (39), 74

Pollination

Wind; apomictic seeds but pollination required to stimulate seed set.

Seeding Methods

Row spacing of 20-60 cm (8-24") recommended; seed in early spring; use a seed carrier.

Seed Weight
2,067,300 seeds/kg (939,700 seeds/lb)

Seeding Rate
164-246 seeds/linear m of row (50-75 seeds/linear ft)

Seeding Depth
0.6 cm (¼")

Seed Germination
98% in 6-14 days.

Stand Establishment
Fair to good; not highly competitive.

Harvest Methods

Expect first seed crop in the second year. Direct combine at the mature seed or swath at hard dough stage; shut off air intake when combining.

Harvest Date
Mid to late June

Shattering Potential
Moderate

Cylinder Speed
1000-1200 rpm

Concave Spacing
0.2-1.0 cm (1/16 - 3/8")
Expected Seed Yield
30-340 kg/ha (27-300 lb/ac)
Stand Life
4 years

Seed Processing

Debearding
Not required
Cleaning
Top screen: 9/64" round
Bottom screen: 20 x 20 mesh
- reduce air intake

Culture

Seed yield will be variable under dryland production; best grown under irrigation. Usually has one peak production year in second or third year. Mow stands closely immediately after harvesting. Somewhat susceptible to powdery mildew and leaf rusts.



alpine bluegrass seed production field

Reclamation Role

An active colonizer of many disturbances in arctic, alpine, and sub-alpine regions; an important species for high altitude reclamation.

Forage Notes

Highly palatable, but does not produce an abundance of forage; moderately used in summer by Rocky Mountain elk.
Grazing Response
Decreaser
Livestock Forage Value
Good
Wild Ungulate Forage Value
Good

Cultivars

Canadian
Blueridge (Vegreville, Alta); Glacier (Vegreville, Alta)



seeds (x 1.9)

Stipa comata Trin. & Rupr.

Synonym(s): includes *S. comata* var. *comata*, *S. intermedia* Scribn. & Tweedy.



needle and thread grass

Plant

Densely-tufted perennial, 30-70 cm tall with roots to 1.5 m and semi-decumbent stems; panicles 10-20 cm long, often only partially exerted from inflated sheaths. Old basal sheaths cling to crowns of older plants. Spikelets relatively large, one-flowered giving rise to single seed; glumes papery, often bristle-tipped, noticeably longer than the lemma.

Vegetative Characteristics

Leaves 1-3 mm wide, forming basal tufts, light or greyish green, leathery, flat to rolled inward or tube-like, ridged and rough on upper surface, smooth or rough on lower, rolled at emergence; sheath round or slightly compressed, split, prominently-veined, with translucent margins; ligule to 4 mm long, conspicuous, often split or frayed; auricles absent. Young leaves are bristle-like.

Seed

8-12 mm long, with a sharply-pointed, hairy callus; lemma pale, evenly hairy, strongly rounded; awn prominent, 10-15 cm long, finely hairy, twisted below and often curled and coiled above; seed hulls (lemma and palea) remain attached to the grain.

Habitat

Dry grasslands; prevalent on sandy or poor soils, and south-facing slopes; requires a minimum of 25 cm mean annual precipitation.

Association(s)

Agropyron smithii, Bouteloua gracilis, Koeleria macrantha and *Carex filifolia* in mixed-grass prairie.

Distribution

Dominant species of the dry central area of the Great Northern Plains; the most widely distributed of the *Stipa* species; sYuk, cSask, sMan, Wisc, Ia, Ind, south to Calif, Ariz, NM, nTex and Mexico.

Phenology

Long-lived, cool-season perennial; starts growth in late April; flowers in late June; seed matures from early July to mid August.

Genetics

2n = 44-46

Pollination

Wind; presumed out-crosser

Seeding Methods

Row spacing of 30-103 cm (12-42") recommended; seed in late summer or just prior freeze-up in the fall.

Seed Weight

250,000 seeds/kg (113,600 seeds/lb)

Seeding Rate

100-164 seeds/linear m of row (30-50 seeds/linear ft)

Seeding Depth

1.8-3.6 cm (¾- 1½")

Seed Germination

45% in 6-14 days with pretreatment #1; 63% in 6-14 days with pretreatment #2; dehulling seeds improves germination in

dormant seed lots.
Pretreatment(s) for dormant seed lots: #1. stratification; #2. GA pretreatment after piercing seed coat.

Stand Establishment
Emergence poor; may require two seasons.

Harvest Methods

Due to indeterminate ripening, the use of strippers is preferred; strip at the mature seed stage or swath at the dough stage when seeds start to turn brown; swath high to reduce trash; direct combining is not recommended.

Harvest Date
Mid to late July

Shattering Potential
High

Cylinder Speed
1000-1200 rpm



seedling - 3 weeks

Concave Spacing
0.5-1.0 cm (3/16 - 3/8")

Expected Seed Yield
112-168 kg/ha (100-150 lb/ac)

Stand Life
4 years

Seed Processing

Debearding
Required; easier at lower seed moisture; multiple runs may be needed.

Scalping
May be required

Cleaning
Top screen: 4½/64 x ½" slotted
Bottom screen: 6 x 24 mesh

Culture

Do not store seed in cotton or burlap sacks as awns will become entangled in the cloth.

Reclamation Role

Colonizes disturbances within its range; for use in range rehabilitation and restoration.

Forage Notes

Cures on stem; protein levels in spring are over 20% dropping to about 5% when cured; provides palatable forage prior to head emergence and after seed drop. Seeds may cause mechanical injuries to grazing livestock and are generally avoided.

Grazing Response
Increaser

Livestock Forage Value
Good

Wild Ungulate Forage Value
Good



seeds (x 1.1)

Cultivars

Canadian
None

Other
None

Stipa curtiseta (A.S. Hitchc.) Barkworth

Synonym(s): *Stipa spartea* var. *curtiseta* A.S. Hitchc.



western porcupine grass

Plant

A bunch grass forming large tussocks, 100 cm tall with roots to 1 m. Old basal leaf sheaths cling to crowns of older plants. Panicles 15-20 cm long, fully exserted, narrow, nodding, with slender branches each bearing 1-2 spikelets; spikelets relatively large, one-flowered giving rise to a single seed; glumes papery, often bristle-tipped, 2-3 cm, noticeably longer than the lemma; lemma 12-15 mm; awn not more than 11 cm long.

Vegetative Characteristics

Leaves to 5 mm wide, light green, shiny, usually flat, ridged and rough on upper surface, smooth below, with indistinct midrib, rolled at emergence; sheath round, split, white or purplish at base, prominently-veined, with translucent, usually hair-fringed margins; ligule to 2 mm long, blunt to rounded, sometimes notched or split, hair-fringed; auricles absent.

Seed

12-15 mm long with a sharp-pointed, hairy callus; lemma brown, hairy at the base and margins, strongly rounded; awn prominent, 5-11 cm long, twice-bent with the last segment straight, twisted below; seed hulls (lemma and palea) remain attached to grain.

Habitat

Moist prairie, openings in the aspen parkland; prefers medium-textured loamy soils; requires more moisture than *S. comata*.

Association(s)

Found with *Festuca hallii*.

Distribution

Dominant species on loam soils in the central part of the Canadian Prairies; BC, sMack to sMan south to Mont, and SD.

Phenology

Long-lived, cool-season perennial; starts growth in late April; seed drops by mid-August.

Pollination

Wind; presumed out-crosser

Seeding Methods

Row spacing of 30-103 cm (12-42") recommended; seed in late summer or just prior freeze-up.

Seed Weight

178,000 seeds/kg (80,900 seeds/lb)

Seeding Rate

100-164 seeds/linear m of row (30-50 seeds/linear ft)

Seeding Depth

1.8-3.6 cm (¾- 1½")

Seed Germination

45% in 6-14 days with pretreatment #1; 52% in 6-14 days with pretreatment #2; dehulling seeds improves germination in dormant seed lots.

Pretreatment(s) for dormant seed lots: #1. stratification; #2. GA pretreatment after piercing seed coat.

Stand Establishment

Emergence poor; may require two seasons.

Harvest Methods

Due to indeterminate ripening, the use of strippers is preferred. Strip at the mature seed stage or swath at

the hard dough stage when seeds start to turn brown. Swath high to reduce trash. Direct combining is not recommended.

Harvest Dates
Late July to mid August

Shattering Potential
High

Cylinder Speed
1000-1200 rpm

Concave Spacing
0.5-1.0 mm (1/16 - 3/8")

Expected Seed Yield
112-168 kg/ha (100-150 lb/ac)

Stand Life
4 years

Seed Processing

Debearding
Required; easier at lower seed moisture; multiple runs may be needed.



seedling - 40 days

Cleaning
Top screen: 1/4 x 1/2" slotted
Bottom screen: 6 x 24 mesh

Culture

Do not store seed in cotton or burlap sacks as awns will become entangled in the cloth.

Reclamation Role

Colonizes disturbance within its range; for use in range rehabilitation and restoration.



seeds before (left) and after (right) debearding (x 1.1)

Forage Notes

Quality of forage somewhat poorer than for *S. comata* but provides palatable forage prior to head emergence and after seed drop. Seeds may cause mechanical injuries to grazing livestock and are generally avoided.

Grazing Response
Decreaser

Livestock Forage Value
Good

Wild Ungulate Forage Value
Good

Cultivars

Canadian
None

Other
None

Stipa viridula Trin.



green needle grass

Plant

A very erect, slender bunch grass, 50-120 cm tall with a dense root system to 2-3 m. Panicles 10-20 cm long, narrow, with slender, appressed branches; spikelets greenish, pale at maturity, one-flowered giving rise to a single seed; glumes noticeably longer than the lemma.

Vegetative Characteristics

Leaves to 5 mm wide, flat to rolled inward or tube-like, rough on upper surface, smoother with prominent midrib below, rolled at emergence; sheath round, split with overlapping margins, prominently-veined, with silky hairs near the throat; ligule to 2 mm long, entire, blunt to rounded; collar yellowish green, narrow, conspicuously hairy; auricles absent.

Seed

5-6 mm long, plump, blackish, with a short, blunt callus; lemma hairy, strongly rounded with a weak awn, 2-3 cm long, twice-bent; seed hulls (lemma and palea) remain attached to the grain.

Habitat

Prairie and aspen parkland; best on heavy clays or moist, fertile soils; also found on sandy sites if there is an underlying water table; prevalent in areas receiving 38 cm mean annual precipitation (minimum 25 mm).

Association(s)

Agropyron smithii on clay soils.

Distribution

A grass of the central Interior Plains of North America; BC, sMack, south to Ariz, NM, Kans, and Minn.

Phenology

Cool-season perennial; starts growth in late April; matures seed by early August.

Genetics

2n = 82. Hybridizes with *Oryzopsis hymenoides* (Indian rice grass).

Pollination

Wind; self-pollinated

Seeding Methods

Row spacing of 30-90 cm (12-36") recommended; seed in spring or just prior freeze-up in the fall.

Seed Weight

399,500 seeds/kg (181,200 seeds/lb)

Seeding Rate

100-164 seeds/linear m of row (30-50 seeds/linear ft)

Seeding Depth

1.5-3.0 cm (⅝- 1⅛")

Seed Germination

45% in 6-14 days with pretreatment #1; 80% in 6-14 days with pretreatment #2; dehulling seeds improves germination in dormant seed lots and/or allowing an after-ripening period of up to two years.

Pretreatment(s) for dormant seed lots: #1. stratification; #2. GA pretreatment after piercing seed coat.

Stand Establishment

Stand establishment is rapid and emerged seedlings have excellent vigour. However, emergence is low (25-40%) even in cultivars or populations selected for low seed dormancy.

Harvest Methods

Expect first seed crop in the second year. Strip when the majority of the seed heads are black or swath at the hard dough stage when seed heads reach 45-50% moisture content. Direct combining is not recommended.

Harvest Date
Mid July to early August

Shattering Potential
Very high

Cylinder Speed
900-1200 rpm

Concave Spacing
0.5-1.0 mm (1/16 - 3/8")



juvenile green needle grass

Expected Seed Yield
100-600 kg/ha
(90-535 lb/ac)

Stand Life
5-8 years

Seed Processing

Debearding
Required

Cleaning
Top screen: 19/64" round
Bottom screen: 1/20" round

Reclamation Role

Used extensively for mine revegetation in the southern Great Plains; also suitable for range rehabilitation or restoration.

Forage Notes

Most palatable of the needle grasses; readily sought out during all stages of growth; spring protein levels 20% dropping to 8% in late fall; moderately resistant to grazing.

Grazing Response
Decreaser

Livestock Forage Value
Good

Wild Ungulate Forage Value
Fair

Cultivars

Canadian
None

Other
Lodorm (ND)



seeds before (left) and after (right) debearding (x 1.1)

Wildflowers



Achillea millefolium L.

Synonym(s): includes *A. millefolium* ssp. *lanulosa* (Nutt.) Piper and *A. millefolium* ssp. *borealis* (Bong) Breitung. The European *A. millefolium* ssp. *millefolium* is closely related to and may be indistinguishable from *A. millefolium* ssp. *lanulosa* and is likely present in Western Canada.



common yarrow

Plant

Aromatic perennial with horizontal rootstocks; forms mats to 60 cm diameter in cultivation; roots fibrous; stems erect, 30-70 cm tall; entire plant sparsely to densely woolly-hairy; plants with a basal tuft of leaves and numerous stem leaves; basal leaves petiolate and fern-like; stem leaves smaller and mostly sessile; inflorescence a flat or round topped cluster of small numerous heads; heads small, radiate and numerous; heads white or rarely pink, with few ray flowers (approx. 5), and more numerous disc flowers (10-30); involucral bracts pale or dark margined.

Seedling Characteristics

Sparsely hairy; first true leaves generally large toothed or once pinnate, later leaves at least twice pinnate; seedlings greener than mature plants.

Seed

Achene lacking a pappus; approximately 2 mm long, oblong, flattened, grey-white to cream, hairless, margin with a narrow wing, surface longitudinally striate.

Habitat

Grasslands and pastures, coulees and depressions in drier areas, open aspen woodlands and clearings, roadsides and disturbed areas, lake shores, stream edges, rocky outcrops, saline flats, and sand dunes.

Distribution

Common in most regions of Alta; less common at higher elevations; Alas, Yuk to nHuds Bay, nQue and Nfld; circumpolar.

Phenology

Long-lived, warm-season perennial; flowers from June to September; seeds mature from July to October.

Genetics

A complex polyploid group; 2n = 18, 27, 36, 45, 54, 72

Pollination

Insect; self-incompatible.

Symbiosis

Actively mycorrhizal in prairie grasslands with vesicular-arbuscular mycorrhizae.

Seeding Methods

Row cropping recommended; 60-90 cm (24-36") row spacing; sow in spring or autumn.

Seed Weight

5,500,000-6,100,000 seeds/kg (2,500,000-2,800,000 seed/lb)

Seeding Rate

375 seeds/linear m of row (115 seed/linear ft)

Seeding Depth

Surface

Seed Germination

99% in 5-15 days; light enhances germination.

Pretreatment(s) for dormant seed lots: #1. stratification; #2. alternating moistening and drying at 22-29°C.

Vegetative Propagation
Rhizome cuttings; divide mature plants.
Stand Establishment
Good; rows fill in rapidly.

Harvest Methods

Expect first significant seed crop in second year. Straight combine or swath; direct heads towards the inside of the swath. For small lots: cut, bag, hang or spread to dry, and thresh. Harvested seeds will remain viable in storage for to 3-5 years.
Harvest Dates
Mid to late August
Shattering Potential
Moderate



seedling - 3 weeks

Cylinder speed
500-900 rpm
Concave Spacing
0.3-0.6 cm (⅛- ¼")
Expected Seed Yield
350-450 kg/ha (320-410 lb/ac)

Stand Life
Approximately 4 years

Seed Processing

Debearding
Not required
Scalping
Required
Cleaning
Top screen: 1/25" round
Bottom screen: 45 x 45 mesh - shut off air intake to reduce air flow

Culture

A. millefolium is a drought tolerant species. In high density plantings, plants remain vegetative and produce fewer flowers and seeds. Inter-row cultivation may be needed to control aggressive rhizomes, which may shorten stand life. An aggressive perennial in garden locations.

Reclamation Role

One of the most successful wild plants, it is able to adapt to a wide array of climates in the northern hemisphere. It is an early colonizer of disturbed sites as well as a component of later seral stages. Recommended as a small proportion of reclamation seed mixes. Seeds exhibit great longevity in the soil seed bank.

Forage Notes

Fair to poor for cattle, young growth fair to good for sheep, usually grazed only when green; grazed by deer in the fall.



seeds (x 1.0)

Grazing Response
Increaser
Livestock Forage Value
Poor-good
Wild Ungulate Forage Value
Good

Cultivars

Canadian
None
Other
Ornamental cultivars are available

Aster ericoides L.

Synonym(s): *Aster ericoides* L. ssp. *pansus* (Blake) A.G. Jones, *Aster pansus* (Blake) Cronq., *Virgulus ericoides* (L.) Reveal & Keener.



tufted white prairie aster

Plant

Perennial; stems several, clustered, from a short rhizome; stems 30-80 cm tall; leaves covered in coarse, white hairs; leaves alternate, linear or linear-oblong, sessile, bearing a short white spine at the apex; heads numerous, usually crowded (often on one side of branch) and short stalked on side branches; ray flowers white, rarely pink, central disc flowers yellow; involucral bracts overlap in three series, outer bracts spine-tipped and hairy or glabrous.

Seedling Characteristics

Leaves ovoid, abruptly pointed at tip, green to blue-green, with stiff, rough, white hairs.

Seed

Achene with a pappus of numerous bristles of uneven length; achene distinctly ridged, tan to light brown when dispersed, to 2 mm long.

Habitat

Dry open areas, grasslands, meadows, disturbed areas and roadsides; frequently on heavy clay soils and alkaline or saline conditions.

Distribution

In Alta: mixed and fescue grasslands, aspen parkland, and occasionally in the boreal region; from BC to sQue, Me; south to Wash, Ore, Utah, Ariz, Tex, Ark, Ill, and nVt.

Phenology

Warm-season perennial; blooms from late July to September; seeds mature from September to October.

Genetics

2n = 10, 20

Symbiosis

Actively mycorrhizal in prairie grasslands with vesicular-arbuscular mycorrhizae.

Seeding Methods

Row cropping recommended; 60-90 cm (24-36") row spacing.

Seed Weight

1,587,000 seed/kg (720,000 seeds/lb)

Seeding Rate

375 seeds/linear m of row (115 seed/linear ft)

Seeding Depth

Surface to very shallow

Seed Germination

99% in 5-10 days with pretreatment. Pretreatment(s) for dormant seed lots: gibberellic acid bath (45 min at 300 ppm GA).

Vegetative Propagation

Rhizome cuttings; stem cuttings; divide mature plants.

Harvest Methods

Expect first significant seed crop in the second year. Straight combine or swath; direct heads towards the inside of the swath. Light-weight windrows may be subject to blowing by wind. For small lots: cut and bag, hang or spread to dry, and thresh.

Harvest Dates

Early to mid September

Shattering Potential

Moderate

Cylinder Speed
500-900 rpm
Concave Spacing
0.3-0.5 cm (⅛- 3/16")
Stand Life
4-5 years

Seed Processing

Debearding
Required to remove pappus
Scalping
Required
Cleaning
Top screen: ½2" round
Bottom screen: 45 x 45 mesh
- shut off air intake to reduce air flow

Reclamation Role

It can spread quickly in open areas with little competition and it plays an important role in soil stabilization. This species is useful in areas of high alkalinity.

Forage Notes

Increases in response to bison grazing; palatable to cattle in early stages of growth.
Grazing Response
Increaser
Livestock Forage Value
Poor



seeds (x 1.0)

Cultivars

Canadian
None
Other
Ornamental cultivars are available.



seedling - 3 weeks

Culture

Rhizomatous growth may shorten stand life.

Astragalus alpinus L.



alpine milk vetch

Plant
Perennial; low growing, spreading by slender rhizomes to form large mats; short, leafy stems to 30 cm in height - mostly shorter; leaves pinnate; leaflets 13-25, oval to elliptic, rounded or often with a small notch at the apex; inflorescence short, 1-4 cm long, often raised above (approx. 5 cm) the plant; flowers purple to purple-white, 3-4 cm long; calyx black hairy; pods black hairy, to 1 cm long, reflexed on short stalks.

Seedling Characteristics
Earliest true leaves (approx. 1 pair) are trifoliate; leaflets broadly elliptical, notched at the apex; petiole and leaves with sparse, short, white hairs, margins appear ciliate.

Seed
Light to dark brown, kidney-shaped, 2-3 mm long, smooth.

Habitat
Moist banks, rocky slopes, forest edges and meadows; roadsides and disturbed sites.

Distribution
In Alta: foothills, montane, sub-alpine, and alpine regions in the Rocky Mountains and in boreal areas; Alas, Prince Patrick Is., nBaffin Is, to Nfld; south to Wash, neOre; Alta, Sask, Man, wOnt, James Bay, Que; south to neNev, and NM; circumpolar.

Phenology
Short-lived, cool-season perennial; flowers continuously from early June to September; seeds ripen from mid-June to late September; in cultivation plants flower as early as the beginning of May and continue throughout the entire growing season.

Genetics
2n = 16, 32

Pollination
Insects - likely bumblebees; self-incompatible.

Symbiosis
Forms nodules with rhizobial bacteria to fix atmospheric nitrogen; associated with dematiaceous surface root fungi.

Seeding Methods
Row cropping recommended; 60 cm (24") row spacing. Spring seeding recommended. Seeding in mid August or later may result in winterkill.

Seed Weight
Wild collected: 588,000 seeds/kg (270,000 seeds/lb);
Nursery harvested: 476,000 seeds/kg (216,000 seeds/lb)

Seeding Rate
100-120 seeds/linear m of row (30-35 seeds/linear ft)

Seeding Depth
0.6 cm (¼")

Seed Germination
95-100% in 3-10 days with pretreatment.
Pretreatment(s) for dormant seed lots: scarification (either scratch seed coat or immerse seeds for 5-7 minutes in concentrated sulphuric acid followed by 4-7 successive washes in water).

Vegetative Propagation
Rhizome cuttings; divide mature plants.

Stand Establishment
Good.

Harvest Methods
Expect first significant seed crop in the second year. Use a seed stripper to harvest several times a season. For small lots: cut, bag, hang or spread to dry, and thresh.

Harvest Dates
Early to mid July; a second harvest can be taken off in late August to early September in some years.

Shattering Potential
Moderate
Cylinder Speed
800-1000 rpm
Concave Spacing
0.3-0.5 cm (⅛- ¼")
Expected Seed Yield
125 kg/ha (113 lb/ac)
Stand Life
2-3 years.

Seed Processing

Debearding
Not required; may be used to break up pods
Scalping
Required
Cleaning
Top screen: 5½/64" round
Bottom screen: 6 x 26 mesh



seedling - 6 weeks

Culture

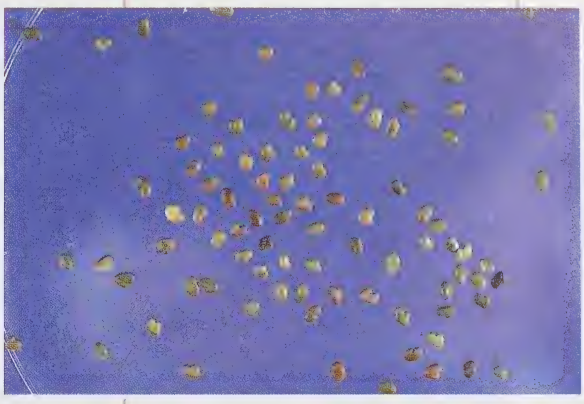
Although some seeds will be produced in the first year, expect the greatest yield in the second year after seeding. Seed production decreases in the third year. Large colonies often die-out in the centre forming an expanding ring.

Reclamation Role

A frequent colonizer of roadsides and disturbed sites in the mountains, foothills and in northern regions of Alberta; effective for erosion control. It is recommended for use to at least 2000 m in the Alberta Rocky Mountains and at lower elevations in northern Alberta. It has also been successfully established on capped tailing sands north of Fort McMurray, on unamended coal mine spoils in several areas of BC (to an elevation of 1930 m) and has shown potential for revegetation of calcareous mine spoils at high elevations in Montana.

Forage Notes

Rocky Mountain bighorn sheep and mountain goats browse foliage, stems, pods, and seeds; hoary marmots, and golden mantled and Columbian ground squirrels eat the flowers; plants do not contain toxic levels of alkaloids or selenium.
Grazing Response
Increaser
Livestock Forage Value
Fair
Wild Ungulate Forage Value
Good



seeds (x 1.0)

Cultivars

Canadian
None
Other
None

Astragalus flexuosus Dougl. *ex* G. Don



slender milk vetch

Plant
Perennial, from deep, stout taproots; rhizomatous; tufted or mat forming; few slender stems (30-100 cm), spreading or growing semi-erect covered in short, white hairs; leaves oddly pinnate, 15-21 leaflets; leaflets narrowly oblong, glabrous above and with stiff, straight hairs appressed to the underside of the blade; inflorescence (to 10 cm long) a terminal raceme; flowers in very open clusters, pink to purple, sometimes white, 6-8 mm long; calyx with white hairs; pods 1-2 cm long, narrowly cylindric, straight or curved, with sparse stiff hairs.

Seedling Characteristics
First true leaves trifoliate, grey-green, long petioled; leaflets oblong, notched at the apex, covered in white hairs, and ciliate margined; entire seedling appears grey-green.

Seed
Approximately 1 mm long, kidney-shaped, smooth, olive green.

Habitat
Open, usually dry gravelly, sandy, and rocky slopes; roadsides, abandoned gravel pits and well sites; moderately alkaline areas.

Distribution
In Alta: most common in fescue grasslands and occasionally in mixed-grass prairie; seBC to sAlta, Sask, Man, and Minn; south to NM and nwKans.

Phenology
Cool-season perennial; emerges in May; flowers in June and July; seeds mature in August and September.

Genetics
2n = 22

Pollination
Insects.

Symbiosis
Associated with rhizobial (nitrogen-fixing) bacteria.

Seeding Methods
Row cropping recommended; 60 cm (24") row spacing; seed in spring or early fall (September).

Seed Weight
498,000 seeds/kg (226,000 seeds/lb)

Seeding Rate
65-130 seeds/linear m of row (20-40 seeds/linear ft)

Seeding Depth
0.6 cm (¼")

Seed Germination
100% in 3-10 days with pretreatment; 3-20% without pretreatment. Pretreatment(s) for dormant seed lots: scarification.

Vegetative Propagation
Rhizome cuttings.

Harvest Methods
Expect first significant seed crop in the second year. The prostrate or semi-erect growth habit of this plant may limit the use of conventional harvest equipment. For small lots: cut, bag, hang or spread to dry, and thresh.

Harvest Dates
August

Shattering Potential
Moderate

Cylinder Speed
800-1000 rpm

Concave Spacing
0.2-0.5 cm (1/16 - 3/16")
Stand Life
To 7 years

Seed Processing

Debearding
Not required; may be used to break up pods
Scalping
Required
Cleaning
Top screen: 1/2" round
Bottom screen: 6 x 32 mesh



seedling - 3 weeks

Reclamation Role

An early colonizer on disturbed gravel and sandy sites. *A. flexuosus* is particularly good along roadsides and abandoned gravel pits. It will tolerate moderately alkaline conditions.

Forage Notes

This species is resistant to trampling damage, and will persist under heavy grazing use.
Grazing Response
Increaser
Livestock Forage Value
Fair

Cultivars

Canadian
None
Other
None



seeds (x 2.0)

Astragalus pectinatus Dougl. *ex* Hook.



narrow-leaved milk vetch

Plant
Perennial; several erect or more commonly spreading stems, 20-60 cm, often with red base, arising from a stout taproot; leaves pinnately compound, each with 9-17 narrowly linear leaflets; leaflets sparsely covered with straight, stiff hairs appressed to the surface; inflorescence a terminal raceme of 10-30 cream to yellow flowers; pods oblong to elliptic, 8-15 mm long, fleshy at first, becoming hard and reflexed at maturity.

Seedling Characteristics
First true leaves trifoliate, green; leaflets lance-shaped, often rolled inward, with soft white hairs.

Seed
2-3 mm long, kidney-shaped, tan to reddish brown, smooth surface.

Habitat
Open prairie grasslands, on eroded slopes, clay banks, and alkaline flats.

Distribution
In Alta: common in mixed-grass prairie, occasional or scattered in fescue grasslands; sAlta, east to sMan; south to Mont, Utah, Colo, and Kans.

Phenology
Cool-season perennial; emerges in April and May; flowering is determinate; blooms in May and early June; seeds mature in July.

Genetics
2n = 22

Pollination
Insects: Various bees species (*Bombus* spp., *Osmia* spp., *Anahophora* spp.); self-incompatible.

Symbiosis
Actively mycorrhizal fungi in prairie grasslands with vesicular-arbuscular mycorrhiza; associated with rhizobial (nitrogen-fixing) bacteria.

Seeding Methods
Row cropping recommended; 60 cm (24") row spacing; seed in spring.

Seed Weight
200,000-260,000 seeds/kg (90,700-118,000 seeds/lb)

Seeding Rate
65-130 seeds/linear m of row (20-40 seeds/linear ft)

Seeding Depth
0.6 cm (¼")

Seed Germination
100% in 3-10 days with pretreatment #1; 7-10% with no pretreatment.
Pretreatment(s) for dormant seed lots: #1. scarification (either abrade seed coat or immerse seeds in hot water (80°C) and leave to soak for 24 hours);
#2. stratification.

Harvest Methods
Expect first significant seed crop in the second year. The prostrate or semi-erect growth habit of this plant may limit the use of conventional harvest equipment. For small lots: cut, bag, hang or spread to dry, and thresh.

Harvest Dates
Mid to late July
Shattering Potential
Very low
Cylinder Speed
800-1000 rpm
Concave Spacing
0.3-0.6 cm (⅛- ¼")

Seed Processing

Debearding
Not required; may be used to further break up pods
Scalping
Required
Cleaning
Top screen: ¾" round
Bottom screen: 6 x 26 mesh



seedling - 3 weeks

Culture

Seeds should be stored at low temperatures to avoid damage by insect larvae. This species is listed as a prohibited noxious weed in the Canadian Seeds Act (1996) due to its toxicity to livestock. Avoid seed production on or near fields where pedigreed crops are being grown.



seeds (x 1.8)

Reclamation Role

It is recommended for revegetation on dry eroded slopes and in alkaline areas of the drier grasslands. This species is now being tested on pipeline rights-of-way.

Forage Notes

Potentially poisonous due to accumulation of toxic levels of selenium in high selenium soils; generally only browsed by livestock when other forage is unavailable.
Grazing Response
Increaser
Livestock Forage Value
Poor

Cultivars

Canadian
None
Other
None

Astragalus striatus Nutt.



ascending purple milk vetch

Plant

Perennial; growing in dense tufts from a liberally branched caudex and a stout, deep taproot; stems erect or spreading, covered in hairs that are attached in the middle; leaves pinnately compound, 13-25 leaflets; leaflets grey-green, elliptic to narrowly oblong, smooth to slightly hairy above and silky hairy beneath; inflorescence a dense, short raceme on a long stalk; flowers purple to white, 1.5-1.8 cm long; pods 7-10 mm long, densely hairy, deeply grooved on one side.

Seedling Characteristics

First true leaves with 1-3 leaflets; leaflets elliptical, tapering to a point, covered with short, white hairs attached by the middle.

Seed

1-2 mm long, kidney-shaped, smooth, brown-black to black.

Habitat

Dry grasslands, roadsides and grassy or open slopes; often on gravelly, rocky, or sandy slopes.

Distribution

In Alta: most common in the foothills fescue grasslands and into the mountains; cAlas, to Yuk, south through Alta, Sask, to Man; south to NM, Kans, and wMinn.

Phenology

Cool-season perennial; emerges in May; flowers from June through August; seeds mature from July through September.

Genetics

2n = 32

Pollination

Insects.

Symbiosis

Actively mycorrhizal in grasslands with vesicular-arbuscular mycorrhizae; associated with rhizobial (nitrogen-fixing) bacteria.

Seeding Methods

Row cropping recommended; 60 cm (24") row spacing. Seed in spring.

Seed Weight

700,000 seeds/kg (317,000 seeds/lb)

Seeding Rate

100-160 seeds/linear m of row (30-50 seeds/linear ft)

Seeding Depth

0.6 cm (¼")

Seed Germination

100% in 3-10 days with pretreatment; 17% germination without pretreatment.

Pretreatment(s) for dormant seed lots: scarification.

Harvest Methods

Expect first significant seed crop in the second year. Direct combining recommended. For small lots: cut, bag, hang or spread to dry, and thresh.

Harvest Dates

Late July to early August

Shattering Potential

Low

Cylinder Speed
800-1000 rpm
Concave Spacing
0.5 cm (3/16")
Stand Life
Approximately 4 years

Seed Processing

Debearding
Not required; may be used to further break up pods
Scalping
Required
Cleaning
Top screen: 1/2" round
Bottom screen: 6 x 32 mesh

Culture

Plants are often eaten down by insects. Seeds should be stored at low temperatures to avoid damage by insect larvae.



seedling - 3 weeks

Reclamation Role

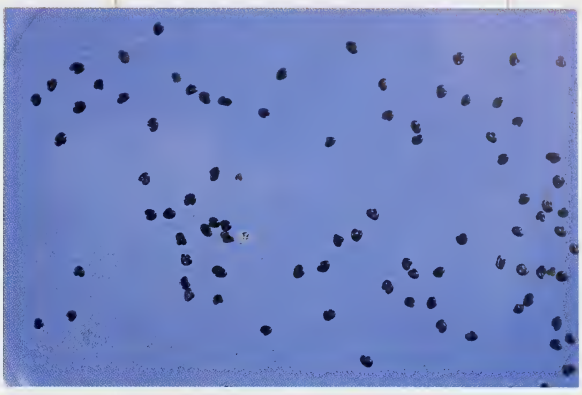
A. striatus is a frequent colonizer of disturbed sites in the mountains and foothills of Alberta.

Forage Notes

Used by livestock to some extent.
Grazing Response
Increaser
Livestock Forage Value
Fair

Cultivars

Canadian
None
Other
None



seeds (x 1.1)

Campanula rotundifolia L.



bluebell

Plant

Perennial; stems tufted from numerous slender rhizomes; slender erect stems, to 40 cm tall, containing a milky sap; leaves glabrous; basal leaves short lived, petiolate, coarsely toothed heart-shaped; stem leaves numerous, linear, smooth; flowers several on slender stalks, rising above leaves in a loose cluster; flower a five-lobed, blue-purple (rarely white) bell; fruit capsule producing many seeds.

Seedling Characteristics

Early leaves, glabrous, kidney-shaped to heart-shaped, round toothed margins.

Seed

1-1.5 mm long, brown to black, elliptical, striate, shiny, slightly winged margins.

Habitat

Depressions in dry meadows, grasslands, open woods, thickets, to alpine elevations.

Distribution

In Alta: mixed-grass, fescue grasslands, aspen parkland, montane, sub-alpine, and boreal areas; not found in the northwest corner; very common in the south; Yuk to Ont, nQue, Lab, Nfld, south to Calif, NM, Tex, Neb, Ia, Pa, NJ; circumpolar.

Phenology

Perennial; emerges early (May); flowers from June to September; seeds mature from August to October.

Genetics

2n = 34, 68, 102

Symbiosis

Actively mycorrhizal in grasslands with vesicular-arbuscular mycorrhizae.

Seeding Methods

Row cropping recommended; 60 cm (24") row spacing.

Seed Weight

1,530,000-2,640,000 seeds/kg (700,000-1,200,000 seeds/lb)

Seeding Rate

350 seeds/linear m of row (100 seed/linear ft)

Seeding Depth

Surface to very shallow

Seed Germination

82% in 5-14 days. Pretreatment(s) for dormant seed lots: stratification.

Vegetative Propagation

Rhizome cuttings; stem-tip cuttings; divide mature plants.

Stand Establishment

Rapid; rows fill in rapidly.

Harvest Methods

Expect first seed crop in the first year. Swath and bale tough; spread to dry; thresh. A mower with a windrowing attachment should be used to swath. Alternatively, a seed

stripper may be used. For small lots: cut and bag, hang or spread to dry, and thresh.

Harvest Dates
Mid September to mid October

Shattering Potential
Low

Cylinder Speed
700-1000 rpm

Concave Spacing
0.6 cm (¼")

Expected Seed Yield
Prolific seed producer

Expected Stand Life
Approximately 5 years

Seed Processing

Debearding
Can be used to further break up pods



seedling - 1 month

Scalping
Required

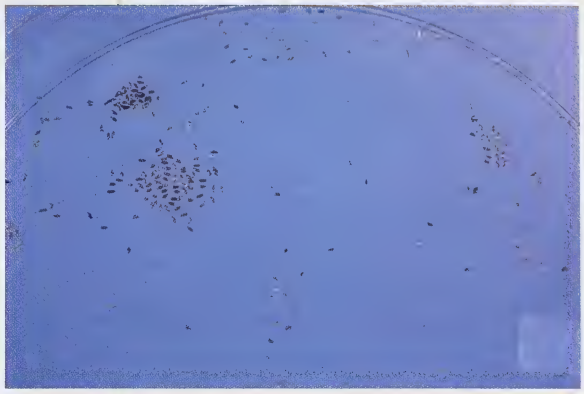
Cleaning
Top screen: 1/25" round
Bottom screen: 45 x 45 mesh
- very light seed; best cleaned with two operations: a screen shaker and a seed blower.

Culture

Rhizomatous growth may shorten stand life. Used as an ornamental in gardens and landscapes where it readily self sows.

Reclamation Role

It is a common component of later seral stages in most grasslands and open clearings. *C. rotundifolia* spreads rapidly on open sites where competition is limited. It is particularly recommended for gravelly, stony, or shallow soils.



seeds (x 1.0)

Forage Notes

Not generally used by livestock; lightly used by Rocky Mountain mule deer.

Grazing Response
Increaser

Livestock Forage Value
Poor

Wild Ungulate Forage Value
Fair

Cultivars

Canadian
None

Gaillardia aristata Pursh



blanket flower

Plant

Perennial; one to many stems from a thick caudex and taproot; stems 20-60 cm long, hairy, little branched; leaves alternate, oblanceolate or lanceolate; basal leaves petiolate, stem leaves sessile, minutely hairy, grey-green, entire, coarsely toothed or pinnatifid; inflorescence a large, solitary, showy head, one to many per plant; rays yellow to orange with a purple base, toothed at apex; disc flowers brown-purple; involucral bracts densely hairy, in 2-3 series, often bent backward.

Seedling Characteristics

Early leaves elliptic to lanceolate, green to grey-green, entire, stiff hairy, petiolate, petiole longer in later leaves.

Seed

Achene 3-4 mm long, conical, grey to black, covered in dense bristles; pappus of 5-10 papery bristles.

Habitat

Dry open areas, particularly on disturbed sites and along roadsides.

Distribution

In Alta: fescue grasslands, mixed-grass prairie (except in driest areas), and openings in the aspen parkland; common in the southern half of Alta; from BC to Man, south to Ore, Utah, Colo and SD.

Phenology

Short-lived perennial; blooms primarily in July and August; seeds mature from late August to October.

Genetics

2n = 34, 68

Pollination

Insect.

Symbiosis

Actively mycorrhizal in prairie grasslands with vesicular-arbuscular mycorrhizae.

Seeding Methods

Row cropping recommended; 60-90 cm (24-36") row spacing.

Seed Weight

345,000-457,000 seeds/kg (156,500-200,000 seeds/lb)

Seeding Rate

160-195 seeds/linear m of row (50-60 seed/linear ft)

Seeding Depth

Surface to very shallow

Seed Germination

70% in 5-10 days.

Pretreatment(s) for dormant seed lots: stratification.

Vegetative Propagation

Divide rooted offspring from parent plants.

Stand Establishment

Good.

Harvest Methods

Expect first significant seed crop in second year. Straight combine or swath; direct heads towards the inside of the swath. For small lots: cut, bag, hang or spread to dry, and thresh.

Blanket Flower, Brown-Eyed Susan or Gaillardia

Harvest Dates
Mid August to late September
Shattering Potential
Low
Cylinder Speed
700-1000 rpm
Concave Spacing
0.6-0.5 cm (¼- 3⁄16")
Stand Life
2-3 years

Seed Processing

Debearding
Required to remove seed husk. Seed husks do not need to be removed from seed for germination/ emergence, however, seed flow may be a problem.
Scalping
Required



seedling - 3 weeks

Cleaning
Top screen: ⅝" round
Bottom screen: 45 x 45 mesh
- shut off air intake to reduce air flow

Culture

Often used as an ornamental in gardens and landscapes. It will also self sow.

Reclamation Role

It is a colonizer of disturbed sites and will persist in small amounts as part of later seral stages.
Recommended for grasslands in the southern and central areas of Alberta, and in the foothills.

Forage Notes

Unpalatable to cattle; light summer consumption by Rocky Mountain mule deer.
Grazing Response
Increaser
Livestock Forage Value
Poor

Cultivars

Canadian
None
Other
Ornamental cultivars are available.



seeds (x 1.0)

Geum triflorum Pursh



three-flowered avens

Plant
Perennial with thick, scaly, black, determinate rhizomes and fibrous roots; forming clusters to 30 cm in diameter; stems erect, 20-40 cm tall; plants hairy throughout; leaves mainly basal, compound, 9-19 leaflets, leaflets pinnate; stem leaves few, opposite, smaller than basal leaves, pinnate; individual stalks with 1-5 (usually 3) nodding flowers; flowers urn-shaped, 5 cream coloured petals, 5 red-purple sepals.

Seedling Characteristics
Seed leaves elliptic, thick and fleshy; first true-leaves petioled, green, coarsely toothed, with stiff short hairs.

Seed
Achene 2-3 mm long, pear-shaped, brown, surface with silky hairs; persistent feathery style, purplish red, 7-9 mm long.

Habitat
Open grasslands, open woods and clearings.

Distribution
In Alta: mixed-grass prairie, fescue grasslands; common in southern Alta; also found in the extreme northeast and along the western edge of Alta; BC to Man, south to Ont, south to Calif, NM, Neb, Iowa, and Ill.

Phenology
Cool-season perennial; blooms from April to June (July); seeds ripen from July to October; plants often wither early in arid areas (i.e early to mid August).

Genetics
2n = 42

Symbiosis
Actively mycorrhizal in prairie grasslands with vesicular-arbuscular mycorrhizae.

Seeding Methods
Row cropping recommended; 60 cm (24") row spacing.

Seed Weight
1,400,000-2,000,000 seeds/kg (635,000-910,000 seed/lb)

Seeding Rate
500 seeds/linear m of row (165 seed/linear ft)

Seeding Depth
Surface to very shallow

Seed Germination
93% in 5-10 days.
Pretreatment(s) for dormant seed lots: stratification.

Vegetative Propagation
Rhizome cuttings; divide mature plants.

Stand Establishment
Good.

Harvest Methods

Expect first seed crop in the second year. Straight combine recommended. For small lots: cut, bag, hang or spread to dry, and thresh.

Harvest Dates
Mid to late July

Shattering Potential
Low

Cylinder Speed
500-900 rpm

Concave Spacing
0.3-0.5 cm (⅛- 3/16")

Stand Life
Approximately 3-4 years



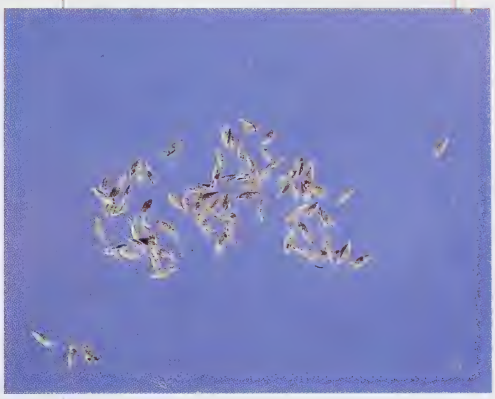
seedling - 3 weeks

Seed Processing

Debearding
Required to increase seed flow however seed husks do not need to be removed from seed for germination/emergence.

Scalping
Required

Cleaning
Top screen: ½" round
Bottom screen: 45 x 45 mesh - shut off air intake to reduce air flow



seeds (x 1.0)

Reclamation Role

This species is part of both early and later seral stages in grasslands.

Forage Notes

Valuable summer forage for Rocky Mountain elk.

Grazing Response
Increaser

Livestock Forage Value
Poor

Wild Ungulate Forage Value
Good

Cultivars

Canadian
None

Glycyrrhiza lepidota (Nutt.) Pursh



wild licorice

Plant
Perennial; from stout, woody rhizomes, and deep roots; stems erect, 30-100 cm, arising singly from rhizomes; leaves odd-pinnate, 11-19 leaflets; leaflets dotted with yellow-brown glands; stipules small and deciduous; inflorescence a dense raceme, 3-4 cm long; flowers numerous, cream to white, 10-15 mm long; calyx glandular; pods 1-2 cm long, reddish brown, with few large seeds, covered in hooked prickles, remain on the plant, unopened, through winter.

Seedling Characteristics
First true leaves uni- to trifoliate with larger terminal leaflets; leaflets oval; seedlings green, lax.

Seed
3-5 per pod, 4 mm long, kidney-shaped, brown to olive green.

Habitat
Moist waste places, depressions, and protected coulees; shorelines, river banks, and canal margins.

Distribution
In Alta: relatively common in mixed-grass prairie, fescue grasslands, aspen parkland; uncommon in northern regions and at high elevations; seBC to Ont, south to Calif, Ariz, Tex, Mo, and Minn.

Phenology
Perennial; flowers in late June and July; seeds mature from September to October.

Genetics
2n = 16

Pollination
Insects.

Symbiosis
Actively mycorrhizal in prairie regions with vesicular-arbuscular mycorrhizae; associated with rhizobial (nitrogen-fixing) bacteria.

Seeding Methods
Row cropping recommended; 60-90 cm (24-36") row spacing; seed in spring.

Seed Weight
136,000-150,000 seeds/kg (62,000-68,000 seeds/lb)

Seeding Rate
100-150 seeds/linear m of row (30-45 seeds/linear ft)

Seeding Depth
0.9 cm (⅜")

Seed Germination
99% in 3-8 days with pretreatment; <90% without pretreatment. Pretreatment(s) for dormant seed lots: scarification.

Vegetative Propagation
Rhizome cuttings; stem (tip or internode) cuttings.

Harvest Methods
Expect first significant seed crop in the second year. Swathing preferred; direct combining not recommended

due to wrapping of stems. For small lots: cut, bag, hang or spread to dry, and thresh.

Harvest Dates
Early August

Shattering Potential
Very low

Cylinder Speed
1000-1400 rpm

Concave Spacing
0.9-1.2 cm (⅜- ½")

Stand Life
5-7 years

Seed Processing

Debearding
Usually required to further break up pods

Scalping
Required



seedling - 1 month

Cleaning
Top screen: ⅝" round
Bottom screen: ⅓" round

Culture

Seeds should be stored at low temperatures to avoid damage by insect larvae.

Reclamation Role

It is an early (to mid) seral species with good potential for use in reclamation due to the formation of large, stabilizing mats.

Forage Notes

Generally avoided by livestock especially later in the season; browsed early in the season by deer; heavily utilized in summer and fall by Rocky Mountain elk and mule deer.

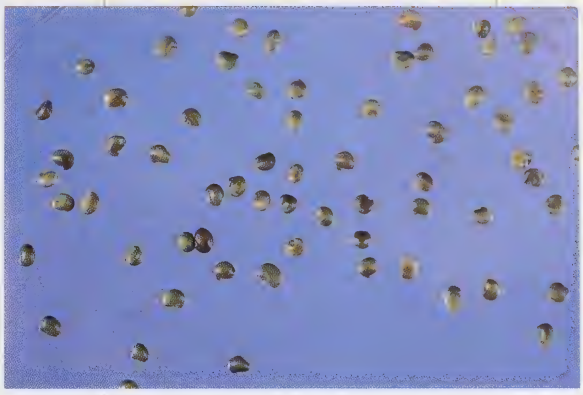
Grazing Response
Increaser

Livestock Forage Value
Poor

Cultivars

Canadian
None

Other
None



seeds (x 1.0)

Hedysarum alpinum L. ssp. *americanum* (Michx.) Fedtsch. /*H. boreale* Nutt. /*H. sulphurescens* Rydb.

Synonym(s): for *H. boreale*: *Hedysarum boreale* var. *boreale* Nutt. and var. *mackenzii* (Rich.) Hitchc., *Hedysarum mackenzii* Rich.



American sweetbroom

Plant

Perennials with few to numerous ascending or erect stems from a caudex and taproots; leaves oddly pinnate; flowers borne in leaf axils, wings and standards shorter than the truncate keel; seed pod (loment) flat, jointed, indehiscent or breaking between loment sections. *H. alpinum*: one to many stems from a thick crown and a thick, woody taproot; stems 20-70 cm tall, hairy with straight, appressed hairs; stipules brown; leaves with 11-21 broadly lanceolate to oblong leaflets, each with an abrupt, short points; leaflets smooth above, sparsely hairy beneath, conspicuously veined on both surfaces; inflorescence a narrow, pointed raceme; flowers pendant, pink to red-purple; loments green, brown with age, smooth to hairy. *H. boreale*: stems ascending; hairy; leaves with 9-13 leaflets; leaflets with obscure veins, hairy (at least below); wings, standard and keel similar in length; flowers in a denser, more compact raceme, erect, red-purple to bright pink; loments hairy, segments not wing-margined. *H. sulphurescens*: few to several stems arise from a woody base; stems 20-60 cm, with stiff straight, appressed hairs; stipules brown; leaves with 9-17 leaflets; leaflets elliptical to ovate-oblong, with abrupt short points at tip, conspicuously veined, sparsely hairy below, hairless above; flowers yellow to cream; loments hairless, with 2-4 segments, with broad, winged margins.

Seedling Characteristics

H. alpinum: seed leaves thick, fleshy; first true leaves with three remote leaflets; green; seedlings of the other two species are very similar and best distinguished by leaf characteristics as older, larger leaves emerge.

Seed

H. alpinum: 3 mm long, brown to purple-black, kidney-shaped, smooth; *H. boreale*: similar to previous seeds but darker brown and more uniform in colour. *H. sulphurescens*: similar but larger, to 5 mm, tan to dark brown.

Habitat

Mesic to moist grasslands (where precipitation exceeds 33-35 mm annually); opens woods, open and rocky slopes in foothills and mountains to 2100 m. *H. alpinum* very common on roadside disturbances throughout Alberta.

Distribution

H. alpinum: In Alta: common in fescue grasslands, scattered in aspen parkland (primarily in openings and along roadsides and trails), scattered in moister areas of mixed-grass prairie; also occasionally on roadsides in northern regions, common in sub-alpine regions and scattered in alpine areas; Alas, Yuk, northern islands, nMack to Huds Bay, Nfld, south to BC, Mont, Wyo, Sask, Man, SD, cOnt, Vt, and Me; Asia. *H. boreale*: In Alta: primarily in the mountains to alpine elevations (to at least 2100 m), also scattered in the mixed-grass prairie, and occasionally in northern areas; range is similar to the previous species but extends to neOre, Ariz, NM, nTex, and wOkla; not found in Asia. *H. sulphurescens*: In Alta: restricted to grasslands, and meadows in the mountains and foothills; BC, Alta, Wash, Mont, and Wyo.

Phenology

Cool-season perennials; flowering is indeterminate; they flower from late May to late September; seeds mature in the wild from mid August to mid September for all species. In cultivation seeds begin to mature as early as late June (*H. alpinum* and *H. boreale*) and early July (*H. sulphurescens*).

Genetics

H. alpinum: 2n = 14, 28;
H. boreale: 2n = 16

Pollination

Insects - bumblebees; often seeds are empty, likely due to lack of pollinators.

Symbiosis

All three species are associated with rhizobial (nitrogen-fixing) bacteria. *H. alpinum* and *H. sulphurescens* have also been reported to be actively mycorrhizal with vesicular-arbuscular mycorrhizae.

Seeding Methods

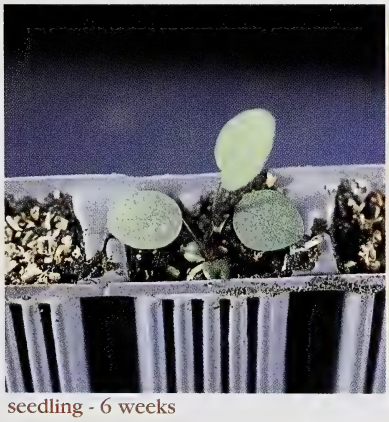
Row cropping recommended; 60-90 cm (24-36") row spacing; seed in spring or early fall (September).

Seed Weight
H. alpinum: wild collected: 230,000 seeds/kg (104,000 seeds/lb); nursery harvested: 260,000 seeds/kg (118,000 seeds/lb);
H. boreale: 200,000 seeds/kg (90,700 seeds/lb);
H. sulphurescens: wild collected: 164,000 seeds/kg (74,000 seeds/lb); nursery harvested: 160,000 seeds/kg (73,000 seeds/lb)

Seeding Rate
80-100 seeds/linear m of row (25-30 seeds/linear ft)

Seeding Depth
0.6-0.9 cm (¼- ⅜")

Seed Germination
H. alpinum: 90-92% in 3-5 days with pretreatment; 30-40% in 10-15 days without pretreatment; acceptable emergence has been recorded with some seed lots where seed pods were not removed.
H. boreale: dark preferable.
Pretreatment(s) for dormant seed lots: scarification (mechanical scarification of seed lots is difficult due to varying degrees of hardness; some seed loss occurs due to breakage).



seedling - 6 weeks

Vegetative Propagation
H. alpinum: stem (tip or internode) cuttings, in spring.

Stand Establishment
Generally slow; stand development requires two full years. *H. alpinum:* higher soil moisture needed for adequate emergence than *H. boreale.*

Harvest Methods
Expect first significant seed crop in the third year (two years after seeding). Direct combining or swathing recommended. For small lots: cut, bag, hang or spread to dry, and thresh.

Harvest Dates
Late July to early September

Shattering Potential
High

Cylinder Speed
700-1000 rpm

Concave Spacing
0.9-1.2 cm (⅜- ½")

Expected Seed Yield
H. alpinum: 50 kg/ha (45 lb/ac) *H. boreale*: 75 kg/ha (67 lb/ac)
H. sulphurescens: 5 kg/ha (4.5 lb/ac)

Stand Life
5-6 years

Seed Processing

Debearding
Required; loments are hard to crack; seeds are easily damaged; best not to process seed until time for seeding

Scalping
Required

Cleaning
Top screen: 7-7½/64" round
Bottom screen: ⅕" round
Commercial *Hedysarum* species' are successfully cleaned and dehulled using a beet decorticator. This method also scarifies seeds.

Culture
Hedysarum species are susceptible to insect damage from seed weevils (*Acanthoscelides* spp.) and seed beetles. *H. alpinum* seeds are often empty due to lack of pollination.

Reclamation Role
All species are components of both early and late seral stages and have been reported to colonize disturbed sites in the mountains and foothills. *H. alpinum* is a common pioneer of disturbed sites such as roadsides. *H. boreale* frequently colonizes disturbed areas, and provides niches for other colonizing plants.



seeds: American sweetbroom (left), boreal sweetbroom (centre) and yellow sweetbroom (right) (x 1.0)

H. sulphurescens is a colonizer on coal mine spoils in the Rocky Mountains and has been recommended for disturbed sites in Montana to enhance grizzly bear and large game habitat.

Forage Notes
H. alpinum: moderately nutritious for game and most livestock (particularly sheep) throughout the season; tannin content reported to be too high to be acceptable as a forage crop; heavy use of this species is usually an indication of overgrazing; this species is used by hoary marmots in the mountains.
H. boreale: used by Rocky Mountain bighorn sheep. *H. sulphurescens*: browsed by Rocky Mountain bighorn sheep, and by elk and mule deer in the summer; used by Columbian and golden mantled ground squirrels and black bears; it is especially used in very early and late seasons by grizzly bears. All species browsed moderately in spring and heavily in summer by mule deer.

Grazing Response
Increaser

Livestock Forage Value
Poor-fair

Wild Ungulate Forage Value
Fair-good

Cultivars

Canadian
None

Other
None

Liatris punctata Hook.



dotted blazing star

Plant

Perennial; one to many stems from a thick corm bearing lateral roots; stem hairless, 20-60 cm tall; leaves few to many, mostly alternate and imbricate on stems, entire, linear, 1.5-2 cm long, 8-10 cm wide, with translucent dots or pits, white margins bearing short hairs; inflorescence of numerous flower heads in a spike-like arrangement; heads sessile, composed of several (generally 4-6, sometimes more) purple-rose-pink (rarely white) disc flowers.

Seedling Characteristics

Upright plants, first true leaves 2.5- 4 cm long, lanceolate - almost grass-like, with a thick prominent vein, minutely dotted or pitted.

Seed

Achene, 6-10 mm long, cylindric to elongated fusiform, grey-black, surface covered by short hairs, 10-ribbed, with a plumose pappus.

Habitat

Common on dry grasslands and exposed hills (often on south slopes); roadsides; common on sandy soils.

Distribution

In Alta: fescue grasslands, mixed-grass prairie, and southern aspen parkland; Sask, Man, to Mont, NM, Tex, Okla, Ark, Minn, and Mich.

Phenology

Long-lived, warm-season perennial; flowers from July to September; seeds mature from mid September to mid October.

Genetics

2n = 20, 40

Pollination

Insect.

Symbiosis

Actively mycorrhizal in prairie grasslands; vesicular-arbuscular mycorrhizae.

Seeding Methods

Row cropping recommended; 60-90 cm (24-36") row spacing.

Seed Weight

200,000-408,000 seeds/kg (90,700-185,000 seeds/lb)

Seeding Rate

200 seeds/linear m of row (60-65 seed/linear ft)

Seeding Depth

0.6-1.2 cm (¼- ½")

Seed Germination

60% in 5-10 days. Pretreatment(s) for dormant seed lots: stratification.

Vegetative Propagation

Stem tip cuttings in early summer (with limited success).

Stand Establishment

Slow

Harvest Methods

Expect the first significant seed crop in the second or third year. Swathing recommended; direct heads towards the inside of the swath. For small lots: cut, bag, hang or spread to dry, and thresh. Seeds difficult to separate from heads.

Dotted Gay Feather or Dotted Blazing Star

Harvest Dates
Mid September to early October
Shattering Potential
Low to none
Cylinder Speed
1000-1400 rpm
Concave Spacing
0.9-1.2 cm (⅜- ½")
Stand Life
10 years

Seed Processing

Debearding
Required to remove pappus
Scalping
Required
Cleaning
Top screen: 5½/64" round
Bottom screen: 32 x 32 mesh
- adjust air flow.



seedling - 1 month

Culture

Occasional spring mowing can increase head production.

Reclamation Role

An important component of diverse grassland communities. Reported to have exceptionally good emergence and vigourous seedling growth on coal mine spoils in North Dakota.



seeds before (left) and after (right) debearding (x 1.0)

Forage Notes

Early growth palatable and nutritious particularly for sheep; becomes unpalatable with age and rarely grazed by livestock later in the year; young plants are browsed by deer and pronghorn; highly valuable fall forage for Rocky Mountain elk; resistant to trampling and grazing.
Grazing Response
Increaser
Livestock Forage Value
Poor-good
Wild Ungulate Forage Value
Good

Cultivars

Canadian
None
Other
Some cultivars have been reported from the USA but no information is available at this time.

Linum lewisii Pursh

Synonym(s): *Linum perenne* L. ssp. *lewisii* (Pursh) Halt.



wild blue flax

Plant
Perennial from fibrous roots; one to several erect, hairless stems, 20-70 cm tall; leaves linear, 1-2 cm long, alternate on stems; flowers 2-3.5 cm diameter, 5 conspicuous light-blue petals, often with lines of lighter colour; flowers are arranged in small, loose terminal clusters, or scattered singly along upper branches.

Seedling Characteristics
Single or a few slender, erect stems with linear stem leaves; entire seedling green-blue, glaucous; seed leaves oval, succulent.

Seed
4-5 mm long, dark brown-black, lighter margins, flattened, teardrop-shaped, with finely dotted surface.

Habitat
Mesic to moist grasslands, dry open woodlands, foothills slopes and montane ridges; often in disturbed areas such as roadsides and railway rights-of-way.

Distribution
In Alta: mixed-grass prairie, fescue grasslands, and less commonly in aspen parkland; Alas, Yuk, to James Bay, BC, Alta, Sask, to Que, south to Calif, and NM, Tex, Okla, Wisc, Gt Lakes.

Phenology
Short-lived perennial; flowers in June and July; seeds mature from July through September.

Genetics
2n = 18

Pollination
Wind.

Symbiosis
Actively mycorrhizal in prairie grasslands with vesicular-arbuscular mycorrhizae.

Seeding Methods
Row cropping recommended; 60-90 cm (24-36") row spacing.

Seed Weight
602,000-645,000 seeds/kg (273,000-293,000 seeds/lb) but has been reported to be as high as 800,000 seeds/kg.
Seeding Rate
95-115 seeds/linear m of row (30-35 seed/linear ft)
Seeding Depth
Surface to very shallow
Seed Germination
73% in 5-12 days; germinates best at 12-15°C but will germinate at temperatures as low as 5°C. Pretreatment(s) for dormant seed lots: none.
Vegetative Propagation
Stem tip cuttings (with limited success); divide mature plants.
Stand Establishment
Good.

Harvest Methods
Expect first significant seed crop in the second year. Combining not recommended due to wrapping of stems. Use of a seed stripper recommended. For small lots: cut, bag, hang or spread to dry, and thresh.
Harvest Date
Early August
Shattering Potential
High

Cylinder speed
400-700 rpm
Concave Spacing
0.3-0.5 cm (⅛- 3/16")
Expected Yield
896 kg/ha (815 lb/ac) under irrigation
Stand Life
4-5 years

Seed Processing

Debearding
Used to further break up capsules
Scalping
Required
Cleaning
Top screen: ¼" round
Bottom screen: ½" round
- adjust air flow

Culture

This species is often used as an ornamental in gardens and landscapes.



seedling - 1 month

Reclamation Role

An early seral species, but will persist in small amounts in later stages.

Forage Notes

Palatable in early spring; utilized by livestock if better quality forage is sparse; contains small amounts of cyanide.
Grazing Response
Increaser
Livestock Forage Value
Poor
Wild Ungulate Forage Value
Fair

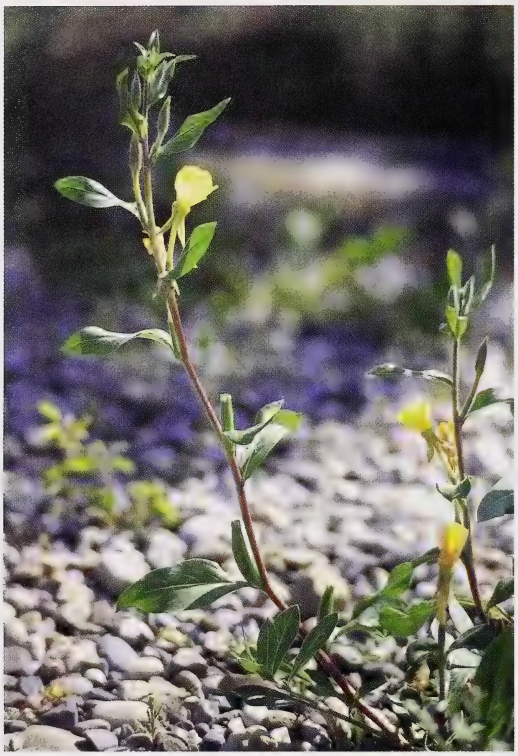
Cultivars

Canadian
None
Other
Lewis (USA)



seeds (x 1.3)

Oenothera biennis L.



yellow evening primrose

Plant

Biennial or short-lived perennial; stout taproot with fleshy, fibrous roots; generally forms a basal rosette of leaves in the first year; stems erect (50-150 cm tall) from the basal rosette of leaves in the second (and sometimes subsequent) year(s), few to many branched, grey-red and hairy; basal leaves dark green to red, 8-30 cm long, long petioled, with a wavy and/or toothed margin; cauline leaves dark green, alternate, sub-sessile, narrowly lance-shaped to oblong, entire margins or minutely toothed; flowers large 2.5-5 mm diameter, yellow, fragrant, and ephemeral; several to many flowers arranged in spikes; fruit an erect, dehiscent capsule.

Seedling Characteristics

Leaves large, short petioled; leaves with few crenate teeth, hairless; leaves and petioles green (sometimes red tinged); entire seedling flat to soil surface.

Seed

1-2 mm long, irregular, angular shape, rugose surface.

Habitat

Moist to dry waste areas and disturbances such as roadsides, railway rights-of-way, well sites, and along ditches, in the grasslands; clearings and disturbed areas in aspen and mixed woodlands.

Distribution

In Alta: mixed-grass prairie, fescue grasslands, aspen parkland, and occasionally in the boreal areas; common in southern Alta; BC, Sask, Man, to Que, Nfld, NB, PEI, NS; south to Wash, Mont, Ida, Tex, and nFla.

Phenology

Winter annual or biennial; flowers in July and August; seeds mature from late August to September.

Genetics

2n = 14, 28

Pollination

Likely by moths.

Symbiosis

Actively mycorrhizal in aspen parkland regions of Alberta with vesicular-arbuscular mycorrhizae.

Seeding Methods

Row cropping recommended; 60-90 cm (24-36") row spacing. Seed in late spring to early summer or in late summer for seed production in the following year.

Seed Weight

3,100,000-3,500,000 seeds/kg (1,400,000-1,600,000 seeds/lb)

Seeding Rate

150 seeds/linear m of row (45-50 seeds/linear ft)

Seeding Depth

Surface to very shallow

Seed Germination
73% in 5-12 days.
Pretreatment(s) for dormant seed lots: stratification.
Vegetative Propagation
Stem tip cuttings.
Stand Establishment
Rapid.

Harvest Methods
Expect first significant seed crop in the second year. Straight combine. For small lots: cut, bag, hang or spread to dry, and thresh.
Harvest Dates
Late August to early September
Shattering Potential
Low
Cylinder Speed
700-1000 rpm
Concave Spacing
0.5-0.6 cm (3/16 - 1/4")


seedling - 3 weeks

Expected Yield
A prolific seed producer
Stand Life
2 years

Seed Processing
Debearding
Not required
Scalping
Required
Cleaning
Top screen: 1/22" round
Bottom screen: 45 x 45 mesh
- shut off air intake to reduce air flow


seeds (x 1.0)

Culture
O. biennis is a winter annual or biennial. It will sometimes persist over several years but it is recommended that new stands be established following harvest.

Reclamation Role
An early and prolific colonizer of natural and man-made disturbances. Basal rosettes produced in the first year from stout taproots provide erosion control.

Forage Notes
Poor forage value for livestock and plants are rarely grazed. Plants of *O. biennis* are often browsed by deer although their forage value is unknown.
Grazing Response
Increaser
Livestock Forage Value
Poor

Cultivars
Canadian
None
Other
None

Oxytropis cusickii Greenm.

Synonym(s): *O. campestris* (L.) DC. var. *cusickii* (Greenm.) Barneby, *O. alpicola* (Rybd.) M.E. Jones.



alpine loco-weed

Plant

Perennial; low plants from a thick multiple caudex; stemless; stipules glabrous or nearly so; leaves oddly pinnate, 4-12 cm long, with 7-15 leaflets; leaflets oblong to elliptic, variably hairy; scapes erect, ascending or prostrate, 2.5-15 cm long; inflorescence a short raceme with 3-15 flowers; flowers pale yellow to cream, calyx 7-9 mm long with dark and light hairs; pods oblong-ovate, with a papery texture, often with dark and light hairs.

Seedling Characteristics

Seedlings covered with long white hairs; first true leaves unifoliate; leaflets elliptic.

Seed

Small (approx. 1.5 mm long), kidney-shaped, dark brown to black, smooth, shiny.

Habitat

Meadows, rocky and gravelly slopes, stony ridges.

Distribution

In Alta: alpine and sub-alpine areas in the Rocky Mountains; BC, Alta, south to Wash, Mont, Wyo, Utah, nColo, and neOre.

Phenology

Cool-season perennial; flowers early in spring, soon after snow melt (June and July); seeds mature in August and September. In cultivation, flowers in mid May to early June; seeds mature from late May to early July.

Genetics

2n = 48

Pollination

Insects.

Symbiosis

Associated with rhizobial (nitrogen-fixing) bacteria.

Seeding Methods

Row cropping recommended; 60 cm (24") row spacing; seed in spring.

Seed Weight

352,000 seeds/kg (160,000 seeds/lb)

Seeding Rate

175-180 seeds/linear m of row (50-55 seeds/linear ft)

Seeding Depth

0.6 cm (¼")

Seed Germination

98% in 3-8 days with pretreatment. Pretreatment(s) for dormant seed lots: scarification.

Harvest Methods

Expect first significant seed crop in the second year. Direct combine. For small lots: cut, bag, hang or spread to dry, and thresh.

Harvest Dates
June
Shattering Potential
Moderate
Cylinder Speed
800-1000 rpm
Concave Spacing
0.5 cm (⅜")
Expected Seed Yield
60 kg/ha (54 lb/ac)
Stand Life
3-4 years

Seed Processing

Debearding
Not required; may be used to further break up pods
Scalping
Required
Cleaning
Top screen: 5½/64" round
Bottom screen: 6 x 32 mesh



seedling - 1 month

Reclamation Role

An early colonizer on harsh alpine and sub-alpine sites and is suitable for use in high elevation reclamation.

Forage Notes

Grazing Response
Increaser
Livestock Forage Value
Poor

Cultivars

Canadian
None
Other
None



seeds: late yellow loco-weed (right) and alpine loco-weed (left) (x 1.1)

Oxytropis deflexa (Pall.) DC.

Synonym(s): includes *O. deflexa* var. *foliolosa* (Hook.) Barneby, *O. deflexa* var. *sericea* T.G.



reflexed loco-weed

Plant
Perennial plants with up-curved, hairy stems to 40 cm although usually shorter; stipules green, leafy; leaves oddly-pinnate; leaflets 15-30, lance shaped, hairy on both sides, decreasing in size from base to tip of leaf; inflorescence 2-3 cm long, sparse, 5-25 flowers; flowers bluish-white or purple-tipped; pods hairy, almost 2 cm long, oblong, pendulous or reflexed, often appearing to one side of stalk.

Seedling Characteristics
First true leaves 3-5 foliate, green, sparsely hairy with long, white, hairs.

Seed
Kidney-shaped, 1-1.5 mm long, brown.

Habitat
Open woodlands, roadsides, shorelines and gravel bars; often found as an invader in lawn boulevards.

Distribution
In Alta: moist grasslands, foothills and mountains, aspen parkland, and boreal; generally not in mixed-grass areas or at high elevations; Alas, Yuk, Mack, to wBaffin Is., James Bay, across to Nfld; Gaspé; south to Wash, Ore, NM, ND; nNorway; Asia.

Phenology
Short-lived, cool-season perennials; flowers from June to August (early flowering plants may flower again in late August or September); seeds mature in August and September. In cultivation, flowers from May to August; seeds ripen from early June to October.

Genetics
2n = 16

Pollination
Insects.

Symbiosis
Associated with rhizobial (nitrogen-fixing) bacteria.

Seeding Methods
Row cropping recommended; 60 cm (24") row spacing; seed in spring.

Seed Weight
1,100,000 seeds/kg
(498,850 seeds/lb)

Seeding Rate
100-165 seeds/linear m of row
(30-50 seeds/linear ft)

Seeding Depth
0.6 cm (¼")

Seed Germination
98% in 3-5 days with pretreatment. Pretreatment(s) for dormant seed lots: scarification.

Harvest Methods
Expect first significant seed crop in the second year. The semi-erect growth habit of this plant may limit the use of conventional harvest equipment. Growing plants close together in each row could improve the habit for harvesting. Use a seed stripper for several harvests in a

season. For small lots: cut, bag, hang or spread to dry, and thresh.

Harvest Dates
June to October

Shattering Potential
Moderate to high

Cylinder Speed
800-1000 rpm

Concave Spacing
0.5 cm (3/16")

Expected Seed Yield
200 kg/ha (178 lb/ac)

Stand Life
2-3 years

Seed Processing

Debearding
Not required; may be used to further break up pods

Scalping
Required



seedling - 1 month

Cleaning
Top screen: 1/16" round
Bottom screen: 6 x 32 mesh

Culture

Plants are often short-lived in cultivation but are prolific seed producers.

Reclamation Role

An early to mid-seral species, it colonizes disturbed sites in the mountains and foothills, and has been reported to colonize old coal mine spoils in Alberta. Seedings have been successful in sub-alpine areas of Alaska. It is recommended for use in mixtures for roadsides and other waste places.

Forage Notes

Grazing Response
Increaser

Livestock Forage Value
Poor

Cultivars

Canadian
None

Other
None



seeds (x 1.0)

Oxytropis sericea Nutt. var. *spicata* (Hook.) Barneby /*O. monticola* A. Gray

Synonym(s): for *O. monticola*: *Oxytropis campestris* (L.) DC. var. *gracilis* (A. Nels.) Barneby.



late yellow loco-weed

Plant

O. sericea: tufted, stemless perennial, from thick, multiple caudex and deep taproot; stipules hairy on back; leaves odd-pinnate, 4-30 cm long, silver green with silky hairs; leaflets 7-17, oval to oblong-lance shaped; leafless flower stalks 7-30 cm long, erect or ascending; inflorescence a dense raceme, 6-27 flowers; flowers pale yellow to white; calyx with dark and light hairs; pods 1.5-2.5 cm long, oblong, short hairy, beaked, and leathery to rigid. *O. monticola*: tufted, stemless perennial, from thick, multiple caudex and deep taproot; stipules hairless to silky hairy below; leaves odd-pinnate, 17-33 leaflets, 6-23 cm long; leaflets linear-oblong to obovate, 6-25 mm long, with long silky hairs appressed above and below; inflorescence a raceme, 10-30 flowered; flowers pale yellow, cream or white - occasionally blue, pink or purple tinged; calyx hairy often with black hairs; pods membranous or papery; ovate-oblong, hairy with black and white hairs

Seedling Characteristics

O. monticola: first true leaves, mostly trifoliate, covered with long, appressed hairs; leaflets elliptic.

Seed

O. sericea: approximately 2 mm long, brown to olive, kidney-shaped, dotted or slightly pitted surface. *O. monticola*: approximately 2-2.5 mm long, brown-black, smooth, kidney-shaped (for seed photo see *O. cusickii*).

Habitat

Dry grasslands, rocky ledges, and gravelly slopes; *O. monticola* also common on disturbed sites such as roadsides and waste places.

Distribution

O. sericea: In Alta: common in fescue grasslands, in the mountains to 1200 m and scattered in the mixed-grass prairie; also found in the Peace grasslands area; sAlas, Yuk, swNWT, Alta, Sask, swMan, south to Nev, Utah, NM, Tex, Okla.
O. monticola: In Alta: common in fescue grasslands, and frequent in mixed-grass prairie; in the mountains to at least 1800 m; sAlta (occasionally farther north); seBC, to swMan, south to Wash, Mont, nColo, SD.

Phenology

Cool-season perennials; *O. sericea*: flowers from mid May to early July; seeds mature in July and August. In cultivation, flowers from early May to mid July; seeds mature in June and early July; may have a second flush in mid August to mid September with small amounts of seeds produced in September and early October.
O. monticola: flowers in June and July (as late as early October); seeds ripen in late August to September. In cultivation, flowers in June and July but may continually flower throughout the summer; seeds mature late July but can vary from late June to early October.

Genetics

O. sericea: 2n = 48;
O. monticola: 2n = 32, 48

Pollination

Insects. *O. monticola*: bumblebee pollinators.

Symbiosis

Both species are associated with rhizobial (nitrogen-fixing) bacteria; *O. sericea*: actively mycorrhizal with vesicular-arbuscular mycorrhizae.

Seeding Methods

Row cropping recommended; 60 cm (24") row spacing; seed in spring.

Seed Weight

O. sericea: wild collected: 555,000 seeds/kg (200,000 seeds/lb), nursery harvested: 435,000 seeds/kg (197,000 seeds/lb);
O. monticola: wild collected:

770,000-830,000 seeds/kg (350,000-376,000 seeds/lb), nursery collected: 650,000 seeds/kg (295,000 seeds/lb).

Seeding Rate
175-200 seeds/linear m of row (55-65 seeds/linear ft)

Seeding Depth
0.6 cm (¼")

Seed Germination
95% in 3-5 days with pretreatment. Pretreatment(s) for dormant seed lots: scarification.

Vegetative Propagation
O. sericea and *O. monticola*: divide the caudex (with limited success).

Harvest Methods

Expect first significant seed crop in the second year. Direct combine. For small lots: cut, bag, hang or spread to dry, and thresh. Susceptible to lodging.



late yellow loco-weed seedling - 1 month

Harvest Dates
O. sericea: late June to early July; a second harvest can be obtained in some years in late September;
O. monticola: July to August

Shattering Potential
Moderate

Cylinder Speed
800-1000 rpm

Concave Spacing
0.3-0.6 (⅛- ¼")

Expected Seed Yield
O. sericea: 350 kg/ha (312 lb/ac)
O. monticola: 250 kg/ha (223 lb/ac)

Stand Life
3 years

Seed Processing

Debearding
Not required; may be used to further break up pods

Scalping
Required

Cleaning
O. sericea: Top screen: ½" round
Bottom screen: 6 x 32 mesh
O. monticola: Top screen: ⅓" round
Bottom screen: 6 x 32 mesh

Culture

This species is listed as a prohibited noxious weed in the Canadian Seeds Act (1996) due to its toxicity to livestock. Avoid seed production on or near fields where pedigreed crops are being grown.

Reclamation Role

Both species colonize disturbed sites in the mountains and foothills of Alberta and each has been suggested for use in reclaiming calcareous mine spoils in Montana. *O. sericea* has been recommended on crushed shales mine spoils in British Columbia. *O. monticola* has been used with some success in sub-alpine areas in Alaska and is recommended for use on disturbed sites to 1800 m in Alberta.



seeds: early yellow loco-weed (x 1.3)

Forage Notes

Unpalatable - only eaten by livestock when more nutritious forage is scarce; both species are moderately browsed by mule deer. *O. sericea:* generally considered poisonous to livestock - particularly horses. All above-ground parts are eaten by Rocky Mountain bighorn sheep and elk; mountain goats browse the foliage; hoary marmots eat the flowers. *O. monticola*: also considered poisonous to livestock however may be less harmful than *O. sericea.*

Grazing Response
Increaser

Livestock Forage Value
Poor

Wild Ungulate Forage Value
Good

Cultivars

Canadian
None

Other
None

Oxytropis splendens Dougl. *ex* Hook



showy loco-weed

Plant

Perennial densely hairy, silvery plant from a branched caudex and thick taproot; leaves pinnate, with leaflets arising in whorls around the central stalk; leaflets numerous, lance-shapes, in whorls of 3-4, arising at 7-15 sites along the stalk; inflorescence a dense, hairy, raceme, with 12-35 flowers, 3-8 cm long; flowers bluish to reddish purple drying to violet; pods ovoid, 10-17 mm long, short-beaked, densely hairy silver, with a deep groove below.

Seedling Characteristics

First true leaves trifoliate, with a long petiole; leaflets elliptic, covered with long, white hairs below, hair more sparse above.

Seed

Kidney-shaped, 2-2.5 mm long, dark brown to black.

Habitat

Grassy slopes, open woods, clearings, gravelly river flats, banks, and roadsides.

Distribution

In Alta: widely distributed in the mountains and foothills; Alas, Yuk, Mack, east and south to Lk Superior, south to sBC, NM, ND, and nMinn.

Phenology

Perennial; flowers from late June to August; seeds mature in August and September. In cultivation flowers mid June to mid August, and often has a second flush of flowers in late August to October; seed mature late June to early September, and as late as early October.

Genetics

2n = 16

Pollination

Insects.

Symbiosis

Actively mycorrhizal in prairie grasslands with vesicular-arbuscular mycorrhizae; associated with rhizobial (nitrogen-fixing) bacteria.

Seeding Methods

Row cropping recommended; 60 cm (24") row spacing; seed in spring.

Seed Weight

wild collected: 770,000 seeds/kg (350,000 seeds/lb); nursery harvested: 715,000 seeds/kg (324,000 seeds/lb).

Seeding Rate

175-200 seeds/linear m of row (55-65 seeds/linear ft)

Seeding Depth

0.6 cm (¼")

Seed Germination

100% in 3-8 days with pretreatment; 5-10% without pretreatment. Pretreatment(s) for dormant seed lots: scarification.

Harvest Methods

Expect first significant seed crop in the second year. Direct combine. For small lots: cut, bag, hang or spread to dry, and thresh. Susceptible to lodging.

Harvest Dates
Late July to early August
Shattering Potential
Moderate to high
Cylinder Speed
800-1000 rpm
Concave Spacing
0.3-0.6 cm (⅛- ¼")
Expected Seed Yield
100 kg/ha (89 lb/ac)
Stand Life
3-5 years

Seed Processing

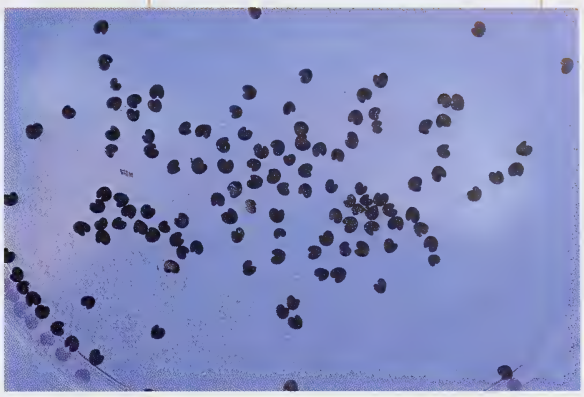
Debearding
Not required; may be used to further break up pods
Scalping
Required
Cleaning
Top screen: ⅕" round
Bottom screen: 6 x 26 mesh

Forage Notes

May be poisonous to livestock, however considered less harmful than *O. sericea*; lightly browsed by elk.
Grazing Response
Increaser
Livestock Forage Value
Poor

Cultivars

Canadian
None
Other
None



seeds (x 1.1)



seedling - 3 weeks

Reclamation Role

An early colonizer of disturbed gravel areas; colonizes disturbed sites and unamended coal spoils in the Rocky Mountains.

Petalostemon purpureum (Vent) Rydb.



purple prairie clover

Plant
Perennial with slender, leafy stems from a multiple caudex and a very long taproot; stems erect to prostrate, to 40 cm long, hairless or sparsely hairy; leaves compound; leaflets 3-7, 5-20 mm long, rolled inward, hairless or sparsely hairy, glandular dotted below; inflorescence a dense, terminal, globose to ovoid, many-flowered spike, 1-5 cm long; flowers purple to violet, very small, hairy; pods small, enclosed by a persistent calyx, with 1-2 seeds.

Seedling Characteristics
First true leaves green, trifoliate; leaflets elliptic to lance-shaped, sometimes notched at apex; hairless or very sparsely hairy, glandular dotted especially below.

Seed
Kidney-shaped, to 2 mm long, olive green to brown, with surface dots or pits.

Habitat
Prairie grasslands, dry banks, hillsides and eroded slopes; generally in areas with greater than 35 mm annual precipitation.

Distribution
In Alta: mixed-grass prairie, fescue grasslands; sAlta (at lower elevations) as far north as the North Saskatchewan River; west to Ont, south to NM, Tex, Ark, and Ala.

Phenology
Long-lived, warm-season perennial; blooms in June, July and August; seeds mature in August and September.

Genetics
2n = 14

Pollination
Insects.

Symbiosis
Actively mycorrhizal in prairie grasslands with vesicular-arbuscular mycorrhizae; associated with rhizobial (nitrogen-fixing) bacteria.

Seeding Methods
Row cropping recommended; 60-80 cm (24-30") row spacing; seed in spring.

Seed Weight
290,000-550,000 seeds/kg (130,000-250,000 seeds/lb)

Seeding Rate
65-130 seeds/linear m of row (20-40 seeds/linear ft)

Seeding Depth
0.6 cm (¼")

Seed Germination
98% in 3-5 days with pretreatment; removal of outer, hairy coat is recommended as it may hinder germination.
Pretreatment(s) for dormant seed lots: scarification (abrade seed coat or place seeds in hot water (80°C) and allow them to soak for up to 24 hours).

Vegetative Propagation
Stem tip cuttings in early summer.

Harvest Methods

Expect first significant seed crop in the second year. Direct combine or swath and bale tough, spread to dry and thresh. For small lots: cut, bag, hang or spread to dry, and thresh.

Harvest Dates
Mid to late August.

Shattering Potential
Low

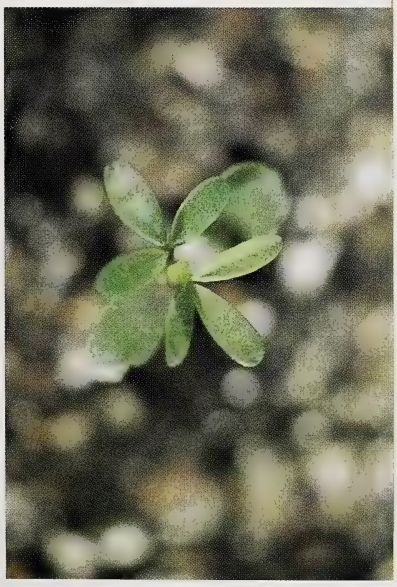
Cylinder Speed
800-1000 rpm

Concave Spacing
0.3-0.5 cm (⅛- 3/16")

Expected Life Stand
5-7 years

Seed Processing

Debearding
Required; to remove hairy outer coating.



seedling - 3 weeks

Scalping
Required

Cleaning
Top screen: 1/16" round
Bottom screen: 6 x 32 mesh

Reclamation Role

P. purpureum is an early seral species and will colonize disturbances particularly in sand, gravel and on rocky outcrops. It is also an important component of later seral stages in grasslands. It can persist for long periods and is adapted to very dry conditions; the taproot of this species can grow several metres into the soil.

Forage Notes

Young shoots contains high levels of protein and is nutritious for most livestock; may cause bloat; lightly used in summer by Rocky Mountain mule deer.

Grazing Response
Decreaser

Livestock Forage Value
Fair

Wild Ungulate Forage Value
Fair

Cultivars

Canadian
None

Other
Some cultivars have been reported from the USA but no information is available at this time.



seeds before (left) and after (right) bedearding (x 1.25)

Ratibida columnifera (Nutt.) Wooten and Standl.



prairie coneflower

Plant

Perennial (often short-lived) from a thick, deep taproot with numerous fibrous roots and a short caudex; few to several stems to 30-60 cm, erect, stiff, coarsely hairy, generally branched; leaves primarily on the stem, alternate, coarsely hairy, glandular-dotted, divided into 5-9 linear or oblong lobes; sometimes leaf lobes are also divided 2-3 times; heads several to many, on long peduncles; ray flowers few, yellow or rarely red-burgundy to purplish, reflexed; disc columnar, many-flowered, 1-4 cm long, grey to yellow to purple brown.

Seedling Characteristics

Few elliptical leaves, entire to minutely toothed, with marginal hairs; upper and lower leaf surfaces with short, stiff, white hairs.

Seed

Achene approximately 2 mm long, grey-black, slightly flattened, slightly winged on inner margins, pappus a crown of small grey scales and 1-2 prominent pappus teeth.

Habitat

Dry to mesic grasslands, depressions in driest areas; especially prevalent on roadsides, and other disturbed areas; adapted to a wide range of soils.

Distribution

In Alta: mixed-grass prairie, fescue grasslands, and occasionally in aspen parkland and montane areas; sBC, to Man, and Ont; south to Calif, Tex, and Ark.

Phenology

Short-lived, warm-season perennial; blooms from July to September; seeds mature from late August through September.

Genetics

2n = 26, 27, 28

Pollination

Insect.

Symbiosis

Actively mycorrhizal in prairie grasslands with vesicular-arbuscular mycorrhizae.

Seeding Methods

Row cropping recommended; 60-90 cm (24-36") row spacing.

Seed Weight

3,000,000 seeds/kg (1,360,000 seeds/lb)

Seeding Rate

350 seeds/linear m of row (100 seeds/linear ft)

Seeding Depth

Surface to very shallow

Seed Germination

68% in 5-15 days.
Pretreatment(s) for dormant seed lots: none.

Vegetative Propagation
Stem tip cuttings.
Stand Establishment
Good.

Harvest Methods

Expect first significant seed crop in second year. Straight combine or swath; direct heads towards inside of swath. For small lots: cut and bag; hang or spread to dry; thresh.
Harvest Dates
September
Shattering Potential
Low
Cylinder Speed
700-1000 rpm
Concave Spacing
0.3-0.5 cm (⅛ - 3/16")
Expected Yield
Prolific seed producer
Stand Life
3-4 years maximum



seedling - 3 weeks

Seed Processing

Debearding
Not required
Scalping
Required

Cleaning
Top screen: 1/16" round
Bottom screen: 1/25" round
- Shut off air intake to reduce air flow

Culture

R. columnifera is a prolific seed producer, but in the wild many of the seeds are unfilled. This species is an attractive landscape species. It will self sow.



seeds (x 1.5)

Reclamation Role

A common colonizer in grassland regions of Alberta. It has shown exceptionally good emergence and vigourous seedling growth on coal spoils in North Dakota.

Forage Notes

Fair to good for sheep and wildlife; fair for cattle; light consumption by mule deer in summer.
Grazing Response
Increaser
Livestock Forage Value
Fair-good
Wild Ungulate Forage Value
Fair

Cultivars

Canadian
None
Other
Ornamental cultivars are available.

Solidago canadensis L. /*S. rigida* L.

Synonym(s): includes *S. canadensis* var. *gilvocanescens* Rydb. and *S. canadensis* var. *canadensis*, *S. pruinosa* Greene, *S. lepida* DC.



Canada goldenrod

Plant

S. canadensis: Robust perennial plants from extensive rhizome systems, often form large patches; stems 30-100 cm tall, mostly erect, upper stems with fine, rough hairs; leaves numerous, mostly along the stem (basal leaves wither early), lance-shaped, gradually tapering to a point, margins entire or toothed, minutely hairy above and below or hairless above; inflorescence a terminal, pyramidal panicle; disc and ray flowers yellow; rays 1-3 (5) mm long. *S. rigida*: stems coarse and rigid, 30-80 cm tall, from a stout caudex; non-rhizomatous; stem leaves oblong to elliptic, mostly entire (not toothed), rigid and firm, finely grey to silvery hairy, leaves reduced in size upwards, upper leaves sessile; basal leaves with long petioles; inflorescence an aggregation of heads into a large open, dense flat-topped cluster; flowers golden yellow.

Seedling Characteristics

S. canadensis: thick, green, obovate leaves, almost hairless, toothed margins near apex, leaves rolled before emergence. *S. rigida*: rigid, green, obovate leaves, ciliate, and with coarse stiff hairs on the upper surface.

Seed

S. canadensis: achenes tan to brown, hairy, with a pappus of fine white hairs. *S. rigida*: achenes to 2 mm, 10-15 nerved, loose hairs near the top, pappus of long white hairs.

Habitat

S. canadensis: usually restricted to mesic to moist sites especially in drier regions, generally in areas with >30 mm annual precipitation; clearings and open woods, thickets, wooded roadsides, in grasslands where moisture is higher such as depressions, sheltered slopes (north and east aspects), and snow melt areas. Often found along roadsides, ditches, canal and stream banks where moisture is not limiting early in the season. *S. rigida*: dry open areas in prairie and woodlands, especially in sandy soils.

Distribution

S. canadensis: In Alta: mixed-grass prairie, fescue grasslands, aspen parkland, boreal and montane areas; most common in Eastern Canada; Alta, Sask, Man, Ont; from Yuk to swMack to Huds Bay, Nfld south to Calif, NM, Tex, and Fla. *S. rigida*: In Alta: common in aspen parkland and parkland fescue grasslands, occasional in foothills grasslands and mixed-grass prairie; sAlta; Sask, Man, Mass, south to NM, Tex, La, and Ga.

Phenology

Both are long-lived, warm-season perennials. *S. canadensis*: flowers in July and August (September); seeds mature from late August to October. *S. rigida*: blooms from August to early October; seeds mature in September and October.

Genetics

S. canadensis: 2n = 18, 36, 54; *S. rigida*: 2n = 18, 36

Pollination
S. canadensis: insect pollinators (honeybees, bumble bees, soldier bees and syrphid flies); cross-pollinating; self-incompatible; 55% pollen viability; no apomixis.

Symbiosis
S. rigida: Actively mycorrhizal in prairie grasslands with vesicular-arbuscular mycorrhizae.

Seeding Methods
Row cropping recommended; 60-90 cm (24-36") row spacing.

Seed Weight
S. canadensis: 2,000,000 seeds/kg (907,000 seeds/lb);
S. rigida: 1,700,000 seeds/kg (770,950 seeds/lb)

Seeding Rate
750 seeds/linear m of row (230 seeds/linear ft)

Seeding Depth
Surface



stiff goldenrod seedling - 3 weeks

Seed Germination
S. canadensis: 78% in 5-12 days; seeds harvested after frost may acquire a secondary dormancy; seeds may also require an after-ripening period. *S. rigida*: 53% in 5-12 days. Pretreatment(s) for dormant seed lots: stratification.

Vegetative Propagation
S. canadensis: Rhizome cuttings; divide mature plants.

Stand Establishment
Good.

Harvest Methods
Expect first seed crop in second year. Straight combine or swath; direct heads toward inside of swath. For small lots: cut, bag, hang or spread to dry, and thresh.

Harvest Dates
S. canadensis: late August to early September;
S. rigida: September

Shattering Potential
Low

Cylinder Speed
500-900 rpm

Concave Spacing
0.3-0.5 cm (⅛ - 3/16")

Expected Seed Yield
S. canadensis:
120 kg/ha (107 lb/ac)

Stand Life
To 10 years

Seed Processing
Debearding
required to remove pappus

Scalping
Required

Cleaning
Top screen: 1/25" round
Bottom screen: 45 x 45 mesh
- shut off air intake to reduce air flow

Culture
S. canadensis: aggressive rhizomes may shorten stand life. Large colonies will often die-out in the centre and form expanding rings.



seeds: stiff goldenrod before debearding (left) and Canada goldenrod after debearding (right) (x 1.0)

Reclamation Role
S. canadensis is recommended for use on moister sites on the Prairies and throughout all other regions to which it is native. This species provides a rapid and complete cover for erosion control and persists in suitable areas. *S. rigida* is not as aggressive as *S. canadensis* and due to its non-rhizomatous habit, it will take a longer period to spread. It is recommended for fescue grasslands and better sites in the mixed-grass prairie.

Forage Notes
Browsed by elk and mule deer.

Grazing Response
Increaser

Livestock Forage Value
Poor

Wild Ungulate Forage Value
Good

Cultivars
Canadian
None

Thermopsis rhombifolia (Nutt.) Richards.



golden bean

Plant

Perennial with single or multiple, leafy stems from extensive, robust, woody rhizomes. Stems erect or ascending, hairless or nearly so, with numerous slender branches; stipules large, oval; leaves trifoliate, hairless, blue-green; leaflets obovate to elliptic, 2-3 cm long, entire, hairless or, less commonly, with silky hairs; inflorescence a short, dense, bracted raceme; flowers 1.5-2 cm long, golden yellow; pods 4-7 cm long, curved into a semi-circle or scimitar-shaped, grey-brown slightly constricted between seed when mature, occasionally somewhat hairy.

Seedling Characteristics

First true leaves trifoliate, glaucous; leaflets oval, hairless, with prominent venation; stipules small, lance-shaped.

Seed

3-6 mm long, kidney-shaped, brown-black to olive green, smooth.

Habitat

Open grasslands on sandy and clay sites, coulees and depression in drier grasslands, open woodlands, roadsides, railroad embankments, waste places and disturbed sites.

Distribution

In Alta: common in most regions; mixed-grass prairie, fescue grasslands, and aspen parkland; not found the mountains nor in northern Alta; seBC to sMan (possibly introduced in sMan); south to Colo, and Neb.

Phenology

Long-lived, cool-season perennial; flowers in May and June; seeds mature from mid July to August; plants often withering by the time seeds mature.

Genetics

2n = 18

Pollination

Insects.

Symbiosis

Actively mycorrhizal in prairie grasslands with vesicular-arbuscular mycorrhizae; roots associated with rhizobial (nitrogen-fixing) bacteria.

Seeding Methods

Row cropping recommended; 60-90 cm (24-36") row spacing; seed in spring (or in fall to provide natural stratification).

Seed Weight
50,000-89,000/kg
(23,000-40,000 seeds/lb)

Seeding Rate
100-150 seed/m
(30-45 seeds/linear ft)

Seeding Depth
1 cm (⅜")

Seed Germination
30-79% in 28 days with pretreatments #1 and #2; 26-66% in

28 days with only pretreatment #1; 5-18% in 28 days with only #2; 2-9% in 28 days with no pretreatment. Mechanical scarification of some seed lots is difficult due to varying degrees of hardness of the seed coats; a small amount of seed loss occurs due to breakage.
Pretreatment(s) for dormant seed lots: #1. scarification; #2. stratification.

Vegetative Propagation
Rhizome cuttings; stem tip cuttings.

Harvest Methods

Expect first significant seed crop in the second year. Direct combine or swath and bale tough, spread to dry and thresh. For small lots: cut, bag, hang or spread to dry, and thresh.

Harvest Dates
Late July to early August

Shattering Potential
Low



seedling - 5 weeks

Cylinder Speed
800-1000 rpm

Concave Spacing
0.9-1.2 cm (⅜- ½")

Stand Life
Approximately 5-7 years

Seed Processing

Debearding
May be used to further break up pods

Scalping
Required

Cleaning
Top screen: ¾" round
Bottom screen: ⅕" round

Culture

Aggressive rhizomes may shorten stand life. Seeds should be stored at low temperatures to avoid damage by insect larvae. This species is listed as a prohibited noxious weed in the Canadian Seeds Act (1996) due to its toxicity to livestock. Avoid seed production on or near fields where pedigreed crops are being grown.

Reclamation Role

T. rhombifolia is an early seral species that can colonize disturbed sites. It is a less frequent component of later seral stages. This species has great potential for reclamation on many types of disturbances; it is commonly observed on recovering well sites, roadsides and unamended coal mine spoils in southeastern Alberta.



seeds (x 1.25)

Forage Notes

Plants are unpalatable to livestock and are generally eaten only if the pasture is over grazed. Some reports indicate that seeds are responsible for some livestock poisoning. Grazed by wildlife early in the season as it emerges from the ground.

Grazing Response
Increaser - plants are resistant to trampling, and spread quickly due to the extensive rhizome system.

Livestock Forage Value
Poor

Cultivars

Canadian
None

Other
None

Vicia americana Muhl.

Synonym(s): includes *V. americana* var. *americana* and *V. americana* var. *sparsifolia* Nutt., *V. sparsifolia* Nutt.



American vetch

Plant

Perennial vine; stems 10-40 cm, spreading to erect depending on nearby supporting plants, branched or unbranched; rhizomatous, occurs as single plants or forms small colonies on bare sites; leaves alternate, pinnately compound, 8-12 leaflets; leaflets 1.5-2 cm long, hairy - especially beneath, linear or narrowly oblanceolate, terminal leaflet replaced with a slender tendril; inflorescence a 2-9 flowered raceme; flowers red-purple to blue-purple, 1-1.5 cm long; pods 1-2 cm long, flat to rounded in cross-section, two to several seeds. Two varieties are found in Alberta: var. *americana* is taller, generally climbing (to 1 m), leaves are thinner and more lax, flowers are smaller (12-20 mm long) and there are a larger number (4-9) of flowers in the inflorescence; var. *sparsifolia* is generally shorter, stems may be more hairy, leaflets are generally narrower and longer and thicker or more firm, flowers are longer (18-22 mm long), and inflorescence has fewer flowers (3-6).

Seedling Characteristics

Extremely slender, thread-like seedlings; first true leaves trifoliate; leaflets 3-6 mm long, lance-shaped tapering to a point at apex.

Seed

4-5 mm, spherical to elliptic, black to olive green, smooth.

Habitat

Grasslands, thickets, open woods, disturbances and abandoned agricultural land; var. *sparsifolia* favours drier sites and disturbed areas; var. *americana* is more shade tolerant than var. *sparsifolia* and is often restricted to protected and moister sites in drier areas.

Distribution

In Alta: common throughout most regions; not generally found in the mountains at higher elevations; var. *sparsifolia*: common in open mixed-grass prairie; var. *americana*: common in fescue grasslands, in protected sites in mixed-grass prairie, aspen parklands, and mixed-wood areas; seAlas, wMack, BC, Alta, Sask, Man, Ont, wQue and Gaspé; south to Calif, NM, Tex, Kans, Okla, Ohio, WVa, and Mo.

Phenology

Long-lived, cool-season perennial; flowers throughout spring and summer; var. *sparsifolia*: blooms earlier, generally in May and June, but may have a second flush; seeds mature from June to early July; var. *americana*: flowers in late June, July, and August; seeds ripen from July to September.

Genetics
2n = 14

Pollination
Insects.

Symbiosis
Actively mycorrhizal with vesicular-arbuscular mycorrhizae; associated with rhizobial (nitrogen-fixing) bacteria.

Seeding Methods
Row cropping recommended; 60 cm (24") row spacing; spring seeding recommended.



seedling - 4 weeks

Seed Weight
60,000-86,000 seeds/kg
(27,000-39,000 seeds/lb)
Seeding Rate
100-150 seeds/ linear metre of row
(30-45 seeds/linear ft)
Seeding Depth
1 cm (⅜")

Seed Germination
78% in 3-7 days with pretreatment; 75% in 14 days without pretreatment.
Pretreatment(s) for dormant seed lots: scarification.
Vegetative Propagation
Rhizome cuttings.

Harvest Methods
Expect first significant seed crop in the second year. Harvesting is simpler if *V. americana* is grown with a sparse nurse crop such as alfalfa; alfalfa seeds are much smaller and easily separated from those of the *Vicia*. Swath and combine; light swaths may blow in the wind; *V. americana* is a very slender plant and harvesting procedures may uproot entire plants. For small lots: cut, bag, hang or spread to dry, and thresh.
Harvest Dates
Early August
Shattering Potential
Moderate
Cylinder Speed
800-1000 rpm
Concave Spacing
0.9-1.2 (⅜- ½")
Stand Life
2-3 years

Seed Processing
Debearding
Not required; may be used to further break up pods
Scalping
Required
Cleaning
Top screen: 8½/64" round
Bottom screen: ⅕" round



seeds (x 1.0)

Culture
The var. *sparsifolia* produces less seed and fails to set seed in some years likely due to a lack of pollination.

Reclamation Role
Var. *sparsifolia* is a colonizer of disturbed sites in grassland regions of Alberta. Often included in reclamation seed mixes to provide palatable forage.

Forage Notes
Palatable to livestock (particularly sheep) throughout the growing season and lightly consumed by mule deer throughout the year. Crude fibre is low; protein is 20% in summer; not tolerant to heavy or continuous grazing and can be easily be grazed out.
Grazing Response
Decreaser
Livestock Forage Value
Good
Wild Ungulate Forage Value
Good

Cultivars
Canadian
None
Other
None

Glossary

Achene	small, dry, single-seeded, indehiscent fruit - particularly found in Compositae species (e.g. *Aster*).
Adventitious Roots	roots that develop in unusual or irregular positions such as from the stem.
After-ripening	the process whereby dry seeds lose dormancy over time.
Apomictic	of a seed: a seed that develops through apomixis (see apomixis).
Apomixis	a natural process in some plant species where seed embryos develop through asexual reproduction.
Appressed	lying flat or close against.
Ascending	of a stem: up-curved from a near prostrate base.
Auricle	ear or claw-like appendage or lobe located at the joint of sheath and blade in grasses.
Awn	of a grass seed: a bristle-like appendage attached to the lemma or glume; also referred to as a beard.
Boot Stage	of a grass plant, developmental stage where the seed head is enclosed inside the sheath.
Bract	a scale or leaf, usually small, subtending a flower or belonging to a flower-cluster.
Breeder Seed	a classification of pedigreed seed from which all other pedigreed seed classes are derived (foundation, registered, and certified).
Callus	a small, hard protuberance.
Calyx	collectively the sepals of a flower.
Caudex	(pl. caudices) the persistent, thickened stem at the base of an herbaceous perennial.
Cauline	pertaining to the stem.
Certified Seed	a classification of pedigreed seed usually produced from foundation or registered seed; the seed class of commerce.
Collar	the band on the outer or lower side of the leaf at the junction of the sheath and blade.

Cool-season Plant	a plant, mostly of temperate origins, completing the major proportion of their growth during the spring and early summer months
Corm	a solid but bulb-like underground stem.
Crenate	scalloped or with rounded teeth.
Cross-pollinating	pollen from a second, separate individual of the same species fertilizes a female flower in the development of a viable seed; see self-pollinating.
Culm	the flowering stem of grasses or sedges.
Cultivar	a named variety of a particular plant species that has specific, known genetic traits and attributes. The genetic integrity of a cultivar is maintained through the production of breeder seed and the regulated production of pedigreed seed for commercial sale in accordance with the Canadian Seeds Act (1996).
Debearder	mechanical device to remove beards or awns or other appendages from grass seed.
Debearding	the action of a mechanical debearder, used usually to remove awns (also called beards) or other appendages from seeds.
Decreaser	a species that decreases in occurrence within a plant community in response to heavy grazing pressure; usually highly productive and palatable to livestock.
Decumbent	of a stem: reclining, but with the tip ascending.
Dehiscent	splitting open along regular lines at maturity.
Dehull	to remove seed hulls, specifically the lemma and palea from grass seed.
Dematiaceous Fungi	fungi that grow in association with roots of certain plants, especially pioneer plants growing on talus or scree slopes in the mountains; although the function of the fungal-root association is unknown the fungi is clearly not pathogenic and could be mycorrhizal.
Determinate	parts of the same plant (e.g. the seed) develop and mature at the same time during the growing season; of rhizomes: rhizome does not continue to grow in length after producing above-ground shoots (compare indeterminate).
Diploid (2n)	an organism with two full chromosome complements in each somatic nucleus; the number of chromosomes in a single full complement is said to be the basic number.
Disc Flowers	tubular flowers that combine to form the central disc in Composites (Aster Family); also called disc florets.
Doubles	of grasses: two adjacent seeds in a head that fail to separate during combining or threshing.

Early Seral	of a plant species; commonly found in plant communities following disturbance; characteristic of an early succession-stage.
Ecotype	the product arising from a genetic response of a population to a particular habitat.
Exserted	extending beyond the surrounding organs, as stamens from the petals and sepals.
Field Capacity	the amount of water remaining in a field soil that has been throughly wetted and drained until free drainage has practically ceased.
Flexuous	zig-zag.
Forage Value	the worth of a plant for grazing; determined by considering palatability, nutritive quality, productivity and prevalence.
Forb	broad-leaf, herbaceous or non-woody plant.
Foundation Seed	a classification of pedigreed seed, produced from breeder seed.
GA	see gibberellic acid.
Gibberellic Acid	a plant hormone often used to break dormancy in seeds.
Glabrous	hairless.
Glaucous	covered by a blue-grey or blue-white powdery substance (bloom).
Glume	a chaff-like bract; specifically one of the two bracts at the base of the grass spikelet.
Hard Dough Stage	of a developing grain: nearly fully ripe and requiring firm pressure to produce an imprint.
Hulls	of grasses: the lemma and palea enclosing the grass flower or grain.
Imbibed	of a seed: when water has been taken up by a seed and the seed has swelled and softened; first step in germination.
Imbricate	overlapping.
Increaser	a species that increases in occurrence within a plant community in response to heavy grazing pressure; usually low growing, less productive, and/or less palatable than decreasers.
Indehiscent	not splitting open at maturity.
Indeterminate	not all parts of the same plant (e.g. the seed) develop and mature at the same time during the growing season; of rhizomes: rhizome continues to grow and produce above-ground shoots at intervals (compare determinate).
Inter-specific Hybrid	a plant resulting from cross-fertilization between two different species.

Invader	species that replace other species within a plant community in response to heavy grazing pressure; usually having no grazing value.
Involucral Bracts	bracts around a flower head (flower-cluster) or a single flower.
Involute	rolled inward.
Keeled	ridged, like a keel of a boat.
Lacerate	irregularly cleft, as if torn.
Late Seral	of a plant species; characteristic of a late succession-stage.
Lemma	the lower of two bracts or hulls enclosing the flower or grain in grasses; see palea.
Ligule	for a grass: a small, thin projection from the top of the leaf-sheath.
Lodging	the breaking or bending of plant stems whereby usually upright plants lie close to the ground making mechanized harvest difficult.
Loment	a legume pod that is constricted between seeds.
Medium Dough Stage	of a developing grain: mature but not fully ripe, requiring medium pressure to produce an imprint.
Named Variety	see cultivar.
Node	a point on a stem from which leaves or branches arise.
Off-types	of a cultivar, plants that do not conform to the varietal standard and must be removed (rouged) from the field crop to maintain the genetic integrity of the cultivar in the production of pedigreed seed.
Out-crosser	a cross-pollinating plant species; see cross-pollinating.
Palea	the upper of two bracts or hulls enclosing the flower or grain in grasses; see lemma.
Panicle	a compound or branched flower-cluster with the lowest branches being the longest; flowers on these lowest branches bloom first; typical of many grasses.
Pappus	hairs, scales, bristles etc. borne on the achene of many Compositae (Aster family) species.
Pedicel	the stalk of each flower in an inflorescence.
Peduncle	the main flower stalk; it supports the flower or clusters of flowers.
Perennial	a plant which persists for more than two seasons.
Petiolate	describing a leaf with a leaf-stem.
Phenology	the timing of plant development stages.

Pinnatifid	usually of a leaf, cleft into numerous and smaller units.
Plumose	having fine hairs on each side, like the plume of a feather.
Pollen	the powdery contents of an anther (part of the male flower), comprised of numerous individual pollen grains that are transferred to and fertilize the female flowers.
Polyploidy	when an organism has three or more full chromosome complements; see diploid.
Population	a community of individual plants of a single species which share a common gene pool.
Raceme	an inflorescence of pedicelled flowers on a common, elongated axis.
Ray Flowers	the strap-like flowers found around the edge of, or throughout the head of many Composites (Aster Family); also called ray florets.
Reclamation	the process of returning disturbed areas to a land productivity equivalent to that prior to disturbance.
Reflexed	turned or bent backwards.
Registered Seed	a classification of pedigreed seed, produced from foundation seed.
Release Site	for a cultivar, the location of the organization that developed and released the cultivar.
Restoration	the process of restoring disturbed lands to conditions existing prior to disturbance.
Revegetation	the process of returning a vegetative cover to a disturbed site.
Rhizomatous	having rhizomes; in grasses: sod-forming.
Rhizome	a creeping, underground stem that can give rise to new plants.
Row Cropping	planting a stand with wide-spaced rows at least 24 inches apart.
Rugose	with a wrinkled surface.
Scalping	coarse screening to remove leafy material from harvested seed; usually done immediately after harvest to prevent heating.
Scapes	a leafless flowering stalk arising from the ground or from a short basal axis.
Scarification	the break down of the outer seed coat by mechanical, physical or chemical means.
Self-incompatible	pollen from a second, separate individual of the same species is absolutely required to fertilize a female flower in the development of a viable seed; see cross-pollinating.

Self-pollinating	pollen from the same plant fertilize the female flowers in the development of a viable seed; see cross-pollinating.
Sessile	not borne on a stalk.
Shattering	when ripe seeds separate and fall away from the flower head.
Sheath	part of the leaf or leaf base which clasps or encloses the stem; particularly in grasses.
Sod-bound	when rhizomatous grasses form very dense mats that hinder further growth.
Spike	an elongated flower-cluster with stemless flowers arranged on a vertical axis.
Spikelet	a small or secondary spike; the characteristic unit of grass flower-clusters.
Sprigging	a procedure where rhizomatous plants are uprooted in small clumps and the clumps are placed onto the surface of the new site with the expectation that they will establish.
Standard	the large upper petal in a legume flower.
Stipule	an appendage borne on the stem near the base of the leaf petiole in some plants.
Stratification	exposing seed to cool, moist conditions to break seed dormancy.
Striate	striped.
Succession	the gradual replacement of one plant community with another in a naturally occurring, progressive development.
Tetrazolium Test	a test (TZ) where seeds are placed in a tetrazolium solution and allowed to imbibe; by interpreting colour of the imbibed seeds one can determine the number of live or viable seeds that have the potential for germination.
Truncate	squared at edge as if cut off abruptly.
TZ	see tetrazolium test.
Warm-season Plant	plants, mostly of tropical origins, completing the major proportion of their growth, during the mid to late summer months, requiring full sunlight and warm temperatures.
Wings	the side two petals of a legume flower; also refers to a thin membranous expansion surrounding or bordering an organ such as a seed.

Geographical Abbreviations

Ala	Alabama
Alas	Alaska
Alta	Alberta
Apal	Appalachia
Ariz	Arizona
Ark	Arkansas
BC	British Columbia
Calif	California
Colo	Colorado
Fla	Florida
Ga	Georgia
Gt Lakes	Great Lakes
Huds Bay	Hudson Bay
Ia	Iowa
Ida	Idaho
Ill	Illinois
Ind	Indiana
Kans	Kansas
La	Louisiana
Lab	Labrador
Mack	District of Mackenzie
Man	Manitoba
Me	Maine
Mex	Mexico
Minn	Minnesota
Mo	Missouri
Mont	Montana
NB	New Brunswick
ND	North Dakota
Neb	Nebraska
Nev	Nevada
Nfld	Newfoundland
NJ	New Jersey
NM	New Mexico
NS	Nova Scotia
NWT	Northwest Territories
Okla	Oklahoma
Ont	Ontario
Ore	Oregon
Pa	Pennsylvania
PEI	Prince Edward Island
Que	Quebec
SAm	South America
Sask	Saskatchewan
SD	South Dakota
Tenn	Tennessee
Tex	Texas
USA	United States
VA	Virginia
Vt	Vermont
Wash	Washington
Wisc	Wisconsin
WVa	West Virginia
Wyo	Wyoming
Yuk	Yukon

Native Plant Councils

Alberta Native Plant Council,
Garneau P.O. Box 52099,
Edmonton, Alberta.
T6G 2T5.

Manitoba Naturalists Society,
401-63 Albert Street,
Winnipeg, Manitoba.
R3B 1G4.
(204) 943-9029.

Native Plant Society of British Columbia,
1805 - 1725 Pendrell Street,
Vancouver, British Columbia.
V6G 2X7.

Native Plant Society of Saskatchewan,
104 - 110 Research Drive,
Saskatoon, Saskatchewan.
S7N 3R3.

Bibliography

Abouguendia, Z. 1995. Seeded Native Range Plants. Grazing and Pasture Tech. Program, Sask. Wetland Cons. Corp and Saskatchewan Agriculture and Food. 32 pp.

Agriculture Canada. 1992. Canadian Methods and Procedures for Testing Seed. Laboratory Services Division, Food Production and Inspection Branch. Agriculture Canada, Ottawa. 113 pp.

Aiken, S.G. and S.J. Darbyshire. 1990. Fescue Grasses of Canada. Agriculture and Agri-Food Canada Publication 1844/E. 113 pp.

Alberta Agriculture, Food and Rural Development. 1997. Crop Protection with Chemicals. Alberta Agriculture, Food and Rural Development. Agdex 606-1.

Alberta Agriculture, Food and Rural Development. 1996. Weed Seedling Guide: Early Detection of Grass and Broad-leaved Weeds. Alberta Agriculture, Food and Rural Development. Agdex 640-9.

Alberta Agriculture. 1983. Weeds of Alberta. Alberta Agriculture and Alberta Environmental Centre. Agdex 640-4.

Alberta Agriculture. 1981. Alberta Forage Manual. Alberta Agriculture. Agdex 120/20-4.

Alberta Native Plant Council. 1998. Native Plant Source List and Collection and Use Guidelines. www.anpc.ab.ca.

Baig, M.N. 1992. Natural revegetation of coal mine spoils in the Rocky Mountains of Alberta and its significance for species selection in land restoration. Mountains Research and Development, 12(3): 285-300.

Bauer, P.J. 1983. Bumblebee pollination relationships on the Montana Beartooth Plateau tundra of southern Montana. American Journal of Botany, 70(1):134-144.

Bell, M.A.M. and C.R. Smyth. 1989. Toxins in Rocky Mountain forage legumes: a preliminary assessment. Prepared for the World Wildlife Fund. Biology Department, University of Victoria.

Bell, M.A.M. and C.R. Smyth. 1987. Forage quality and plant growing season utilization of nine high elevation Rocky Mountain legumes. Prepared for the Canadian Wildlife Service. Biology Department, University of Victoria.

Berg, W.A. 1995. Response of a mixed native warm-season grass planting to nitrogen fertilization. Journal of Range Management, 48:64-67.

Bjugstad, A.J. and W.C. Whitman. 1989. Promising native forbs for seeding on mine spoils. IN: Proceedings - Reclamation: A Global Perspective. Alberta Land Reclamation Council Report No. RRTAC 89-2. pp. 255-262.

Bolton, J.L., D.B. Wilson, and S.R. Smith. 1996. Pedigreed Forage Seed Production. Canadian Seed Growers' Association. Ottawa, Canada. 53 pp.

Campbell, J.B., K.F. Best, and A.C. Budd. 1966. 99 Range Forage Plants of the Canadian Prairies. Canada Department of Agriculture Publication 964.

Canadian Seed Growers Association. 1994. Regulations and Procedures for Pedigreed Crop Production. Circular 6-94.

Currah, R., A. Smreciu, and M. Van Dyk. 1983. Prairie Wildflowers - An Illustrated Manual of Species Suitable for Cultivation and Grassland Restoration. Friends of the Devonian Botanic Garden, University of Alberta. 300 pp.

Currah, R.S. and M. Van Dyk. 1986. A survey of some perennial vascular plant species native to Alberta for the occurrence of mycorrhizal fungi. Canadian Field-Naturalist, 100(3):300-342.

Dewey, D.R. 1984. The Genomic System of Classification as a Guide to Intergeneric Hybridization with the Perennial Triticeae. USDA.-ARS. Crop Research Laboratory, Utah State University, Logan UT. 84322. 270 pp.

Environmental Canada. 1993. Canadian Climate Normals 1961-1990: Prairie Provinces. Atmospheric Environmental Services Canadian Communication Publishing Group. Ottawa, Canada. 266 pp.

Fulbright, T.E., E.F. Redente, and N.E. Hargis. 1982. Growing Colorado Plants from Seed: A State of the Art. Vol. II: Grasses and Grasslike Plants. U.S. Dept. Int. Fish Wildl. Serv. FWS/OBS-82/29. 113 pp.

Gerling, H.S., M.G. Willoughby, A. Schoepf, C. Tannas, and K. Tannas. 1996. A Guide to Using Native Plants on Disturbed Lands. Alberta Agriculture, Food and Rural Development and Alberta Environmental Protection. 247 pp.

Government of Canada. 1996. Canadian Seeds Act. Queen's Printer.

Hardy BBT Limited. 1989. Manual of Plant Species Suitability for Reclamation in Alberta. 2nd Edition. Alberta Land Conservation and Reclamation Council Report No. RRTAC 89-4. 436 pp.

Hartmann, H.T. and D.E. Kester. 1997. Plant Propagation Principles and Practices. 6th Edition. Prentice-Hall, Inc. Englewood Cliffs, New Jersey.

Hartnett, D.C., K.R. Hickman, and L.E. Fischer Walter. 1996. Effects of bison grazing, fire, and topography on floristic diversity in tallgrass prairie. Journal of Range Management, 49(5):413- 420.

Hitchcock, C.L. and A. Cronquist. 1973. Flora of the Pacific Northwest - An Illustrated Manual. University of Washington Press. Seattle, Washington. 730 pp.

Hitchcock, A.S. 1971. Manual of the Grasses of the United States. Vol I and II. 2nd Edition. Revised by A. Chase. Dover Publications. New York, NY.

Jones, T.A., P.J. Urness, and D.C. Nielson. 1996. Technical Note: Spring grazing preference of Wheatgrass taxa by Rocky Mountain Elk. Journal of Range Management, 49(5):474-476.

Joyce, J. 1994. Development and management of native plant materials highlights. IN: Proceedings of a Workshop on the Uses and Importance of Native Plants of Saskatchewan. Saskatchewan Agriculture and Food.

Joyce, J. 1993. Native Plants: Exploring Grass Seed Production and Markets. Agriculture Canada, PFRA and Ducks Unlimited Canada. 53 pp.

Kerr, D. S., L.J. Morrison, and K.E. Wilkinson. 1993. Reclamation of Native Grasslands in Alberta: A Review of the Literature. Alberta Land Conservation and Reclamation Council Report No. RRTAC 93-1. 205 pp.

Kufeld, R.C. 1973. Foods eaten by the Rocky Mountain Elk. Journal of Range Management, 26(2):106-113.

Kufeld, R.C., O.C. Wallmo, and C. Feddema. 1973. Foods of the Rocky Mountain Mule Deer. USDA Forest Service. Research Paper RM-111.

Looman, J. 1983. 111 Range and Forage Plants of the Canadian Prairies. Research Branch, Agriculture Canada, Ottawa. Pub. 1751. 255 pp.

Looman, J. 1982. Prairie Grasses Identified & Described by Vegetative Characteristics. Research Branch Agriculture Canada, Ottawa. Pub. 1413. 244 pp.

Looman, J. and K.F. Best. 1987. Budd's Flora of the Canadian Prairie Provinces. Research Branch, Agriculture Canada, Ottawa. Pub. 1662. 863 pp.

Morgan, J.P., D.R. Collicutt, and J.D. Thompson. 1995. Restoring Canada's Native Prairies: A Practical Manual. Prairie Habitats, Argyle, Manitoba, Canada. 84 pp.

Moss, E.H. 1983. Flora of Alberta. 2nd ed. Revised by J.G. Packer. University of Toronto Press, Toronto.

Nadja, H.G. 1989. Grass Seed Production Under Irrigation. Alberta Agriculture Agdex 127/15-4.

Nadja, H., K. Lopetinsky, M. Bjorge, and B. Witbeck. 1994. Harvesting Grass Seed. Alberta Agriculture, Food and Rural Development. Agdex 127/50-1

Newman, P.R. and L.E. Moser. 1988. Grass seedling emergence, morphology, and establishment as affected by planting depth. Agronomy, 80:383-387.

Packer, J.G. and C.E. Bradley. 1984. A Checklist of the Rare Vascular Plants in Alberta. Provincial Museum of Alberta, Natural History Occasional Paper No.5. Alberta Culture, Historical Resources Division, Edmonton.

Pavlick, L. 1995. *Bromus* L. of North America. Royal British Columbia Museum. Victoria, BC. 160 pp.

Porsild, A.E. 1979. Rocky Mountain Wildflowers. National Museum of Natural Sciences, Ottawa, Ontario.

Russell, W.B. 1984. Natural vegetation and ecology of abandoned coal-mined land at Sterco-coal Valley, Rocky Mountain foothills, Alberta. IN: Workshop Proceedings, Revegetation Methods for Alberta's Mountains and Foothills. Ed. P.F. Ziemkiewicz. Report No. RRTAC 85-1. pp. 101-109.

Small, E., J. Cayouette, and P.M. Catling. 1997. Poorly known economic plants of Canada - 15. Sweet Grass, *Hierochloe odorata* (L.) Beauv. CBA/ABC Bulletin, 30(4):62-64.

Smith, S.R., D. Cattani, D. Feindel, R. Haas, D. Tober, L. Holzworth, M. Majerus, D. Hall, and K. Borcher. 1997. Native Grass Seed Production Manual. (Edited by: S.R. Smith & S. Smith) Ducks Unlimited Canada. Stonewall, Manitoba. 155 pp.

Smreciu, A. 1993. Native Legumes for Reclamation in Alberta. Alberta Conservation and Reclamation Council Report No. RRTAC 93-9. 94 pp.

Smreciu, E.A., R.S. Currah, and E. Toop. 1988. Viability and germination of herbaceous perennial species native to southern Alberta grasslands. The Canadian Field-Naturalist, 102:31-38.

Smyth, C.R. 1997. Native legume transplant survivorship and subsequent seedling recruit on unamended coal mines soils in the Canadian Rocky Mountains. Mountain Research and Development, 17(2): 145-157.

Smyth, C.R. 1997. Native grass, sedge, and legume establishment and legume-grass competition at a coal mine in the Rocky Mountains of southeastern British Columbia. International Journal of Surface Mining, Reclamation and Environment, 11:105-113.

Stevens, R. and K.R. Jorgensen. 1994. Rangeland species germination through 25 up to 40 years of warehouse storage. U.S.D.A. Forest Service. Intermountain Research Station. General Technical Report INT-GTR-313:257-265.

Strong, W.L. and K.R. Leggat. 1992. Ecoregions of Alberta. Alberta Forestry, Lands and Wildlife, Resources Information Branch, Lands Information Services Division, Edmonton, Alberta. 59 pp.

Stubbendiek, J., S.L. Hatch, and C.H. Butterfield. 1992. North American Range Plants. 4th Edition. University of Nebraska Press, Lincoln, Nebraska.

Tannas, K. 1997. Common Plants of the Western Rangelands. Volume 1 - Grasses, Grass-like Species, Trees and Shrubs. Lethbridge Community College, Lethbridge, Alberta. 311 pp.

Tannas, K. 1997. Common Plants of the Western Rangelands. Volume 2 - Forbs. Lethbridge Community College, Lethbridge, Alberta. 310 pp.

Vance, F.R., J.R. Jowsey, and J.S. Mclean. 1984. Wildflowers Across the Prairies. Douglas & McIntyre, Vancouver, BC. 336 pp.

Wark, D.B., W.R. Poole, R.G. Arnott, L.R. Moats, and L. Wetter. 1995. Revegetating with Native Grasses. Ducks Unlimited Canada. Stonewall, Manitoba. 133 pp.

Warwick, S.I. and L. Black. 1982. The biology of Canadian weeds. 52. *Achillea millefolium* L. s.l. Canadian Journal of Plant Science, 62:163-182.

Weaver, J.E. 1954. North American Prairie. Johnsen Publishing Company, Nebraska. 343 pp.

Werner, P.A., I.K. Bradbury, and R.S. Gross. 1980. The biology of Canadian weeds. 45. *Solidago canadensis* L. Canadian Journal of Plant Science, 60: 1393-1409.

White, D.J., E. Haber, and C. Keddy. 1993. Invasive Plants of Natural Habitats of Canada. Canadian Wildlife Service, Environmental Canada, and Canadian Museum of Nature.

Wroe, R.E., S. Smoliak, and G.W. Wheeler. 1986. Alberta Range Plants and their Classification. Alberta Agriculture Agdex 134/6.

Young, J.A. and C.G. Young. 1986. Collecting, Processing, and Germinating Seeds of Wildland Plants. Timber Press Inc., Portland, Oregon. 97225-9962.

Species Index

A

Achillea
millefolium, ...52
millefolium ssp. *lanulosa*, ...52
millefolium ssp. *borealis*, ...52
Agropyron
dasystachyum, ...16
latiglume, ...22
smithii, ...18
subsecundum, ...20
trachycaulum, ...22
unilaterale, ...20
violaceum, ...22
alpine bluegrass, ...43
alpine fescue, ...37
alpine loco-weed, ...81
alpine milk vetch, ...57
American sweetbroom, ...73
American vetch, ...97
ascending purple milk vetch, ...63
aster
tufted white prairie, ...55
Aster
ericoides, ...54
ericoides ssp. *pansus*, ...54
pansus, ...54
Astragalus
alpinus, ...56
flexuosus, ...58
pectinatus, ...60
striatus, ...62
awned wheat grass, ...21

B

bearded wheat grass, ...21
blanket flower, ...67
blazing star
dotted, ...75
blue grama, ...25
bluegrass
alpine, ...43
bluebell, ...65
bluebunch fescue, ...35
blue flax
wild, ...77
bluejoint wheat grass, ...19
boreal sweetbroom, ...73
Bouteloua gracilis, ...24
broad-glumed wheat grass, ...23
brome
fringed, ...27
Bromus
ciliatus, ...26
richardsonii, ...26
brown-eyed Susan, ...67
buffalo bean, ...95

C

Calamovilfa longifolia, ...28
Canada goldenrod, ...93
Campanula rotundifolia, ...64
common evening primrose, ...79
common yarrow, ...53
coneflower
long-headed, ...91
prairie, ...91

D

Deschampsia
cespitosa, ...30
cespitosa var. *mackenziana*, ...31
dotted blazing star, ...75
dotted gayfeather, ...75

E

early yellow loco-weed, ...85
Elymus
lanceolatus, ...16
trachycaulus ssp. *subsecundus*, ...20
trachycaulus ssp. *trachycaulus*, ...22
trachycaulus ssp. *violaceus*, ...22
evening primrose
common, ...79
yellow, ...79

F

fescue
- alpine, .37
- bluebunch, .35
- Idaho, .35
- mountain rough, .33
- northern rough, .33
- plains rough, .33
- Rocky Mountain, .37

Festuca
- *altaica,* .32
- *brachyphylla,* .36
- *campestris,* .32
- *hallii,* .32
- *idahoensis,* .34
- *ovina,* .36
- *ovina* var. *saximontana,* .36
- *ovina* var. *brachyphylla,* .36
- *saximontana,* .36
- *scabrella,* .32

flax
- wild blue, .77

fringed brome, .27

G

gaillardia, .67
Gaillardia aristata, .66
gay feather
- dotted, .75

Geum triflorum, .68
Glycyrrhiza lepidota, .70
golden bean, .95
golden banner, .95
goldenrod
- Canada, .93
- stiff, .93

green needle grass, .49

H

hairgrass
- tufted, .31

harebell, .65
Hedysarum
- *alpinum* ssp. *americanum,* .72
- *boreale,* .72
- *boreale* var. *boreale,* .72
- *boreale* var. *mackenzii,* .72
- *mackenzii,* .72
- *sulphurescens,* .72

Hierochloe odorata, .38
holy grass, .39

I

Idaho fescue, .35

J

June grass, .41

K

Koeleria
- *cristata,* .40
- *gracilis,* .40
- *macrantha,* .40
- *nitida,* .40

L

late yellow loco-weed, .85
Liatris punctata, .74
licorice
- wild, .71

Linum
- *lewisii,* .76
- *perenne* ssp. *lewisii,* .76

loco-weed
- alpine, .81
- early yellow, .85
- late yellow, .85
- reflexed, .83
- showy, .87

long-headed coneflower, .91

M

milk vetch
- alpine, .57
- ascending purple, .63
- narrow-leaved, .61
- slender, .59

mountain rough fescue, .33

N

narrow-leaved milk vetch, .61
needle grass
- green, .49

needle and thread grass, .45
northern rough fescue, .33
northern wheat grass, .17

O

Oenothera biennis, .78
old man's whiskers, .69
Oxytropis
- *alpicola,* .80
- *campestris* var. *cusickii,* .80
- *campestris* var. *gracilis,* .84
- *cusickii,* .80
- *deflexa,* .82
- *deflexa* var. *foliolosa,* .82
- *deflexa* var. *sericea,* .82
- *monticola,* .84

sericea var. *spicata*, ...84
splendens, ...86

P

Pascopyrum smithii, ...18
Petalostemon purpureum, ...88
plains rough fescue, ...33
Poa alpina, ...42
prairie aster
tufted white, ...55
prairie coneflower, ...91
prairie clover
purple, ...89
prairie sand grass, ...29
prairie smoke, ...69
porcupine grass
western, ...47
purple milk vetch
ascending, ...63
purple prairie clover, ...89

R

Ratibida columnifera, ...90
reed grass
sand, ...29
reflexed loco-weed, ...83
Rocky Mountain fescue, ...37
rough fescue
mountain, ...33
northern, ...33
plains, ...33

S

sand grass, ...29
sand reed grass, ...29
showy loco-weed, ...87
slender milk vetch, ...59
slender wheat grass, ...23
Solidago
canadensis, ...92
canadensis var. *canadensis*, ...92
canadensis var. *gilvocanescens*, ...92
lepida, ...92
pruinosa, ...92
rigida, ...92
spear grass, ...45
stiff goldenrod, ...93
Stipa
comata, ...44
comata var. *comata*, ...44
curtiseta, ...46
intermedia, ...44
spartea var. *curtiseta*, ...46
viridula, ...48
sweet grass, ...39
sweetbroom
American, ...73
boreal, ...73
yellow, ...73

T

Thermopsis rhombifolia, ...94
thickspike wheat grass, ...17
three-flowered avens, ...69
tufted hair grass, ...31
tufted white prairie aster, ...55

V

vetch,
American, ...97
wild, ...97
Vicia
americana, ...96
americana var. *americana*, ...96
americana var. *sparsifolia*, ...96
sparsifolia, ...96
Virgulus ericoides, ...54

W

wheat grass
awned, ...21
bearded, ...21
bluejoint, ...19
broad-glumed, ...23
northern, ...17
thickspike, ...17
slender, ...23
western, ...19
western porcupine grass, ...47
western wheat grass, ...19
white prairie aster 55
tufted,
wild blue flax, ...77
wild licorice, ...71
wild vetch, ...97

Y

yarrow
common, ...53
yellow evening primrose, ...79
yellow sweetbroom, ...73

Bibliothèque nationale du Canada
3 3286 51686 5959



7 78753 06138 7

ALBERTA RESEARCH COUNCIL

Printed in Canada

Alberta
AGRICULTURE, FOOD AND RURAL DEVELOPMENT